Conference Abstracts

Table of content

Title

Effects of high-intensity interval training vs. continuous aerobic exercise training on symptomatology and microcirculation in migraine: A three-armed randomized controlled trial (RCT)

Authors/Affiliation

Alice Minghetti[1], Henner Hanssen [1], Lukas Zahner[1], Oliver Faude[1], Lars Donath[1]

[1]Department of Sport, Exercise and Health, University of Basel, Basel, Switzerland

Abstract

Introduction

Migraine is a disabling neurological disease that can negatively affect cardiovascular risk. Available evidence suggests an impairment of vascular function in patients suffering from migraine (Sacco, Pistoia, Degan, & Carolei, 2015). Aerobic exercise training has been shown to improve retinal microvascular structure and function (Hanssen et al., 2011). Retinal vessel analysis is a sensitive non-invasive cardiovascular screening tool. Effects of different exercise intensity modalities on retinal vessel diameters and symptomatology has not yet been studied in patients suffering from migraine.

Methods

24 migraineurs (20 female, 4 male, age: 36.4 (11.0), BMI: 22.9 (4.0), PARQ: 0.83 (0.92), migraine days: 4.6 (2.6), headache days: 8.2 (5.5)) were enrolled in the present RCT. Static Vessel Analysis (SVA-T)) was performed during pre- and post- measurements in order to obtain baseline central retinal arterial (CRAE) and venular (CRVE) diameters and to calculate the arteriolar-to-venular diameter ratio (AVR). Maximal ramp exercise testing on a treadmill was employed to assess maximal (VO_2max) and submaximal (velocity at the individual anaerobic threshold) fitness parameters. Headache (frequency, duration and intensity) and physical activity diaries were kept 4 weeks prior to the start of the study and during the intervention period. Subsequently, participants were randomly assigned to either high intensity interval training (HIT), moderate continuous training (MCT) or the control group (CON). Both intervention groups trained twice a week during a 12-week intervention period. HIT followed a 4x4 interval program alternating between 4 minutes at 90% followed by 3 minutes at 70% HR_{max} (Helgerud et al., 2007) while MCT ran at 70% HR_{max} for 45 minutes. Both training regimen were equicalorically adjusted. In total, 24 training sessions were conducted whereby a minimum of 20 sessions had to be achieved.

Results

Analyses of covariance revealed a large and clinically relevant effect of both interventions on Migraine days (η_p^2=0.14) with slightly larger decreases in favor of HIT (pre: 5.3 (SD: 3.0), post: 3.0 (1.5), Cohen's d: 1.0) compared to MCT (pre: 4.6 (SD: 2.3), post: 3.2 (2.5), Cohen's d: 0.6). A very large effect has been found for all headache days (η_p^2=0.31) with larger effect sizes for HIT (0.50<d<0.81) vs MCT (0.24<d<0.34). VO_2max (HIT: pre: 37 mL/kg/kg (5), post: 42 (9), d=0.8; MCT: pre: 37 mL/kg/kg (6), post: 38 (8), d=0.3) only notably improved in the HIT group. AVR improved after exercise training, showing a large group effect (η_p^2=0.14) in favor of HIT compared to MCT (HIT: pre: 0.89 (0.06), post: 0.92 (0.07), d=0.46); MCT: pre: 0.85 (0.07), post: 0.86 (0.07), d=0.25). The increase in AVR in the HIT group is mainly due to the increase of retinal arteriolar calibers (CRAE) (HIT: pre: 188.0 (0.06), post: 192.8 (20.0), d=0.26) while MCT showed a constriction of retinal venules (CRVE) (MCT: pre: 234.7 (8.5), post: 230.0 (9.6), d=0.5).

Discussion/Conclusion

Both exercise intensity modalities beneficially affected retinal microvascular diameters indicating a reduction of cardiovascular risk in migraineurs. In addition, exercise training reduced migraine attack frequency and headache intensity. HIT seems to be a safe training modality for migraineurs showing more pronounced effects on maximal oxygen uptake, retinal microvascular health and migraine symptomatology compared to MCT. Thus, supervised aerobic exercise should be considered as a complementary treatment strategy for migraineurs.

References

Hanssen, H., Siegrist, M., Neidig, M., Renner, A., Birzele, P., Siclovan, A., … Halle, M. (2012). Retinal vessel diameter, obesity and metabolic risk factors in school children (JuvenTUM 3). *Atherosclerosis*, *221*(1), 242–248.

Helgerud, J., Høydal, K., Wang, E., Karlsen, T., Berg, P., Bjerkaas, M., … Hoff, J. (2007). Aerobic high-intensity intervals improve VO2max more than moderate training. *Medicine and Science in Sports and Exercise*, *39*(4), 665–671.

Sacco, S., Pistoia, F., Degan, D., & Carolei, A. (2015). Conventional vascular risk factors: their role in the association between migraine and cardiovascular diseases. *Cephalalgia: An International Journal of Headache*, *35*(2), 146–164.

Title

Mechanisms of skeletal muscle adaptations to HIIT

Authors/Affiliation

Nicolas Place
Institute of Sport Sciences, University of Lausanne

Abstract

Skeletal muscle adaptations to endurance training depend largely on exercise intensity [1]. In this respect, high intensity interval training (HIIT) has been widely adopted as a method to enhance endurance capacity in both athletes and patients. It is now well established that only a few sessions of HIIT may be beneficial to improve endurance performance, but the underlying mechanisms remain unclear. Type 1 ryanodine receptor (RyR1), the sarcoplasmic reticulum Ca^{2+} release channel, has recently been identified to play a key role in skeletal muscle adaptations to HIIT [2]. In this presentation, a translational approach combining results from myotubes, mouse single fibres, mouse isolated muscles and biopsies from exercising humans will be used to characterize the potential role of RyR1 in response to acute and chronic HIIT.

References

[1] MacInnis, M.J., & Gibala, M.J. (in press). Physiological adaptations to interval training and the role of exercise intensity. J Physiol

[2] Place, N. et al. (2015). Ryanodine receptor fragmentation and sarcoplasmic reticulum Ca^{2+} leak after one session of high-intensity interval exercise. Proc Natl Acad Sci U S A. 112(50):15492-7

Title

Adapting the Bernese Motive and Goal Inventory in leisure and health sports for people in adolescence and young adulthood (BMZI-JFEA)

Authors/Affiliation

Vanessa Gut[1], Julia Schmid[1], Jürg Schmid[1], Achim Conzelmann[1]
[1]Institute of Sport Science, University of Bern, Bern, Switzerland

Abstract

Introduction

Although the benefits of physical activity are well known, especially adolescents and young adults have an above average dropout rate in physical activity (Lamprecht, Fischer, & Stamm, 2014). Being physically active in adolescence is strongly linked with lifelong exercise behaviour and, as a consequence, can lead to improved health and well-being. Therefore, the relevance of a specific exercise promotion for adolescents and young adults is clearly given.

However, target-group-specific interventions are rarely established to maintain and promote physical activity in adolescence and young adulthood. One neglected aspect in health and exercise promotion are personal sport-related motives and goals. Although first studies with motive-based tailoring of sports programmes increased the physical activity and had positive effects on well-being (Sudeck & Conzelmann, 2011). Motives can be defined as stabile valuation dispositions across different situations and times. Thereby it can be distinguished between explicit and implicit motives (Brunstein, 2010). Implicit motives are not accessible to consciousness and can not be measured directly; whereas explicit motives are conscious and can be gathered trough self-report.

One proven and theoretical based questionnaire eliciting motives and goals is the Bernese Motive and Goal Inventory for people from 35 to 64 years in middle adulthood (BMZI; Lehnert, Sudeck, & Conzelmann, 2011). The inventory consists of 24 items with seven dimensions (contact, competition/performance, distraction/catharsis, body/appearance, fitness/health, activation/enjoyment and aesthetics). However, an adaptation of the original BMZI is needed, because motives and goals vary across the lifespan (Trujillo, Brougham, & Walsh, 2004). From a developmental-psychological perspective and based on empirical findings following aspects should be complemented (Grob, 2007; Weiss & Williams, 2004): (1) Differentiation of fitness and health: Considering the current state of research a differentiation of fitness and health for adolescents and young adults can be assumed. With increasing age, the two aspects should begin to merge together. (2) Differentiation of body/appearance: In adolescence and young adulthood a growing importance of the body image can be observed. Therefore, the additional component of body forming should get increased attention. (3) New facet of risk/suspense: Adolescence can be characterised through changes in personality and behaviour. In physical activities young people especially tend to show more risk-taking behaviour and to search excitement. (4) Differentiation of competition/performance: Furthermore, performance enhancement and skill improvement are important aspects for adolescents and young adults to be physically active.

For this reason, the aim of the study is (1) to develop an appropriate questionnaire to assess the sport-related motives and goals of adolescents and young adults from 14 to 34 years (BMZI-JFEA) and (2) to validate the psychometric criteria of the inventory.

Methods

The study is embedded as part of the research project "sport-related motives and goals in adolescence and young adulthood – Adapting the Bernese Motive and Goal Inventory in leisure and health sports" supported by Swiss Federal Office of Sport (FOSPO). The project includes a pretest and three

development phases (see table 1). Hereinafter, the results of study 2 and 3a are presented. The sample of Study 2 consisted of 717 adolescents and young adults (63% women). The age ranged from 14 to 34 years (M_{age} = 19.95, SD_{age} = 3.95). The sample was recruited through public and vocational schools, universities and companies providing services in Switzerland. To examine the retest-reliability another sample of 195 apprentices of a service company received twice an online-version at an interval of 2 weeks. The age ranged from 15 to 26 years (M_{age} = 17.30, SD_{age} = 1.69, 57% women).

For the item generation a systematic literature research in databases and a scanning of the existing inventory was conducted. Additionally to the 24 items of the original BMZI, the existing facets competition/performance, body/appearance, aesthetics and fitness/health were expanded with 9 items and risk and suspense experience as a new facet was complemented with 4 items. Study 2 consists of 37 Items using a 5-point Likert Scale (from 1 = "I disagree" to 5 = "I strongly agree"). Additionally, to validate the discovered motives and goals the sport-related self-concordance (Seelig & Fuchs, 2006) was gathered.

Table 1

Review of the questionnaire development with sample description, steps of item reduction, goal and data analysis

Study	Sample	Steps of item reduction (dimensions)	Goals and data analysis
Pretest	N = 165	41 → 39 + 1 (9)	- Pretesting and communicative validation
1	N = 651	40 → 34 + 3 (9 → 8)	- Explore factorial structure and item reduction: EFA with principal axis factoring and a promax-rotation
2	N = 717	37 → 26 (8)	- Explore factorial structure and item reduction: EFA with principal axis factoring and a promax-rotation - Construct validity: ESEM with a geomin-rotation - Internal consistency: Cronbach`s Alpha - Further construct validation with sport-related self-concordance, sex[1], age[1] and life goals[1] using bivariate correlation analyses with Pearson`s Correlation coefficient
3a	N = 195	26 (8)	- Retest-reliability: bivariate correlation analyses with Pearson`s Correlation coefficient
3b	N =	26	- Cross-validation and examination of the mess invariance for age and sex: ESEM with a target-rotation

Note. [1]Results were not reported.

First, an exploratory factor analysis (EFA) was conducted to explore the factorial structure using SPSS version 24 (see table 1). Second, an exploratory structural equation modeling (ESEM; Marsh, Morin, Parker, & Kaur, 2014) was carried out to confirm the factorial structure using Mplus 7. ESEM as a quiet new statistical analysis for questionnaire development integrates the advantages of EFA and confirmatory factor analysis (CFA). Traditionally, CFA typically does not allow cross-loadings and thus may lead to a distorted factorial structure. In comparison, ESEM incorporates cross-loadings, which represents the underlying structure more realistically and provides a better model fit. Third, Cronbach`s Alpha was calculated to examine the internal consistencies of the found dimensions. Fourth, a further construct validation with sport-related self-concordance and an examination of the retest-reliability with bivariate correlation analyses (Pearson`s Correlation coefficient) were conducted using SPSS version 24.

Results

An EFA with the preliminary data was conducted to identify underlying factors. Factor extraction based on an eigenvalue bigger than one, confirmatory examination of the scree plot and content-related considerations. A 8-factor-solution (KMO = .844, 76% explained variation) with 26 items was provided: contact, competition/performance, distraction/catharsis, body/appearance, fitness, health, aesthetics and risk/suspense. Furthermore, the ESEM confirms the 8-factor structure model with acceptable to good model fit indices (see table 2).

Additionally, a further examination of psychometric criteria was conducted. The internal consistency of the inventory can be classified as good to very good. Cronbach`s Alpha ranged from .77 for competition/performance to .90 for contact. The test-retest-reliability over a 2-week period measured by Pearson`s correlation coefficient ranged from r_p = .62 for fitness to r_p = .81 for competition/performance. To assess the construct validity of the inventory correlation analyses were conducted with sport-related self-concordance which mostly revealed the assumed correlations. Purposed-centred motives and goals show negative correlations with intrinsic motivation (e. g. weight/appearance r_p = -.104, p < .05) whereas activity-centred motives and goals are characterised through positive correlations with intrinsic motivation (e. g. competition/performance r_p = .519, p < .05 and aesthetics r_p = .446, p < .05).

Table 2

Fit indices for the 8-factor model

Model	MLR-χ^2	Free parms	*df*	CFI	TLI	SRMR	RMSEA	90%-CI
8-factor-model	718.775	464	290	.955	.900	.024	.064	.058-.070

Note. MLR = Robust Maximum-Likelihood-Estimation by Yuan-Bentler; df = Deviation of Freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; 90%-CI = 90-Procent-Confident interval for RMSEA.

Discussion/Conclusion

A first validation of the BMZI-JFEA shows a good model fit and is with 26 items an economic inventory. In comparison with the original BMZI a new aspect risk/suspense and a separation of fitness and health was discovered. On the other hand, no clear dimension activation/enjoyment was found. However, a cross-validation is necessary to confirm the factorial structure of the sport-related motives and goals, especially due to the unbalanced gender ratio and relatively young sample for the target group. Furthermore, examining measurement invariance of age and gender is intended. Additionally, the retest-reliability over a 2-week period should be conducted with a more representative sample to provide an explanation for the partially low retest-reliability. Furthermore, based on the BMZI-JFEA the building of motive-based types of sportsperson for adolescents and young adults is planned. With the adapted BMZI-JFEA, the original BMZI and the BMZI for older adulthood (Schmid, Molinari, Lehnert, Sudeck, & Conzelmann, 2014) an age-specific individual diagnosis of sport-related motives and goals across the whole lifespan from 14 to 85 years will be possible.

References

Brunstein, J. C. (2010). Implizite und explizite Motive. In H. Heckhausen & J. Heckhausen (Hrsg.), *Motivation und Handeln* (4. Aufl., S. 237–255). Berlin: Springer.

Grob, A. (2007). Jugendalter. In M. Hasselhorn & W. Schneider (Hrsg.), *Handbuch der Entwicklungspsychologie* (Bd. 7, S. 187–197). Göttingen: Hofgrefe.

8

Lamprecht, M., Fischer, A., & Stamm, H. (2014). *Sport Schweiz 2014: Sportaktivität und Sportinteresse der Schweizer Bevölkerung*. Magglingen: Bundesamt für Sport.

Lehnert, K., Sudeck, G., & Conzelmann, A. (2011). BMZI – Berner Motiv- und Zielinventar im Freizeit- und Gesundheitssport. *Diagnostica*, *57*(3), 146–159.

Marsh, H. W., Morin, A. J., Parker, P. D., & Kaur, G. (2014). Exploratory structural equation modeling: An integration of the best features of exploratory and confirmatory factor analysis. *Annual Review of Clinical Psychology*, *10*(1), 85–110. doi:10.1146/annurev-clinpsy-032813-153700

Schmid, J., Molinari, V., Lehnert, K., Sudeck, G., & Conzelmann, A. (2014). BMZI-HEA. Adaptation des Berner Motiv- und Zielinventars im Freizeit- und Gesundheitssport für Menschen im höheren Erwachsenenalter. *Zeitschrift für Gesundheitspsychologie*, *22*(3), 104–117.

Seelig, H., & Fuchs, R. (2006). Messung der sport- und bewegungsbezogenen Selbstkonkordanz. *Zeitschrift für Sportpsychologie*, *13*(4), 121–139.

Sudeck, G., & Conzelmann, A. (2011). Motivbasierte Passung von Sportprogrammen: Explizite Motive und Ziele als Moderatoren von Befindlichkeitsveränderungen durch sportliche Aktivitäten. *Sportwissenschaft*, *41*, 175–189.

Trujillo, K. M., Brougham, R. R., & Walsh, D. A. (2004). Age differences in reasons for exercising. *Current Psychology*, *22*(4), 348–367.

Weiss, M. R., & Williams, L. (2004). The why of youth sport involvement: A developmental perspective on motivational process. In M. R. Weiss (Ed.), *Developmental sport and exercise psychology: A lifespan perspective* (pp. 223–268). Morgantown: Fitness Information Technology.

Title:

Das sportliche Selbstkonzept und die motorischen Basiskompetenzen als Mediatoren sportlicher Aktivität

Authors/Affiliation:

Christian Herrmann[1], Harald Seelig[1], Uwe Pühse[1] & Erin Gerlach[2]
[1]Universität Basel, [2]Universität Potsdam

Abstract:

Einführung

Sportliche Aktivität im Vereinssport ist Teil eines aktiven Lebensstils, welcher eine Grundlage für verschiedene Gesundheitsparameter darstellen kann. Determinanten der sportlichen Aktivität sind u.a. das *sportliche Selbstkonzept* sowie die *motorischen Kompetenzen* (Robinson et al., 2015). So konnte gezeigt werden, dass Zusammenhänge zwischen den motorischen Kompetenzen, dem Aktivitätsniveau und dem sportlich-physischen Selbstkonzept bestehen (Lubans et al., 2010; Barnett et al., 2016). Dabei wird angenommen, dass Sport- und Freizeitaktivitäten zumindest ein moderates motorisches Kompetenzniveau erfordern, um überhaupt sportlich aktiv sein und am Vereinssport teilnehmen zu können. Im vorliegenden Beitrag wird der Einfluss des *sportlichen Selbstkonzepts* und der *motorischen Basiskompetenzen* als Determinanten sportlicher Aktivität im Verein längsschnittlich untersucht.

Methode

In der von der ESK Schweiz geförderten IMPEQT-Studie wurden 835 Schüler (50 % männlich) in der 7. (t_1: M = 13.2 Jahre; SD = .64) und darauf folgenden 8. Jahrgangsstufe (t_2: M = 14.2 Jahre) längsschnittlich erfasst. Erhoben wurden in der 7. Klasse die *motorischen Basiskompetenzen* „Sich-Bewegen" (z.B. Rollen, Springen) und „Etwas-Bewegen" (z.B. Werfen, Prellen; Herrmann et al., under review), das *sportliche Selbstkonzept* (Gerlach, 2008) sowie die *Vereinssportaktivität* in der 7. und 8. Klasse. Um den mediierenden Einfluss des *sportlichen Selbstkonzepts* und der *motorischen Basiskompetenzen* auf die Veränderung der *Vereinssportaktivität* über ein Jahr zu untersuchen, wurden latente Strukturgleichungsmodelle mit Mediationsanalysen berechnet.

Ergebnisse

Das Modell zeigte eine gute Anpassung an die Daten (CFI = .99; TLI = .98; $RMSEA$ = .030; $WRMR$ = .92). Zu t_1 hatte die *Vereinssportaktivität* einen Einfluss auf das *sportliche Selbstkonzept* (β = .37) und die *motorischen Basiskompetenzen* (β = .33). Die Korrelation des *sportlichen Selbstkonzepts* mit den *motorischen Basiskompetenzen* lag bei (r = .63). Unter Kontrolle der *Vereinssportaktivität* zu t_1 (β = .47), zeigte sich, dass lediglich die *motorischen Basiskompetenzen* einen Einfluss auf die Veränderung der *Vereinssportaktivität* zu t_2 (β = .27) hat. Die *motorischen Basiskompetenzen* stellten damit einen signifikanten Mediator (indirekter Effekt: β = .09) der Veränderung der *Vereinssportaktivität* dar.

Diskussion

Motorische Basiskompetenzen stehen in einem engen Zusammenhang mit dem *sportlichen Selbstkonzept* und spielen eine bedeutsame Rolle für die sportliche (Vereins-) Aktivität. Entsprechend könnte die Entwicklung der *motorischen Basiskompetenzen* ein wichtiger Mechanismus sein, um positive Gesundheitsverläufe im Kindes- und Jugendalter zu fördern (Stodden et al., 2008).

References

Literatur

Barnett, L. M., Lai, S. K., Veldman, S. L. C., Hardy, L. L., Cliff, D. P., Morgan, P. J., . . . Okely, A. D. (2016). Correlates of Gross Motor Competence in Children and Adolescents: A Systematic Review and Meta-Analysis. *Sports Medicine*.

Gerlach, E. (2008). *Sportengagement und Persönlichkeitsentwicklung: Eine längsschnittliche Analyse der Bedeutung sozialer Faktoren für das Selbstkonzept von Heranwachsenden*. Aachen: Meyer & Meyer.

Herrmann, C., Seiler, S., Pühse, U., & Gerlach, E. (under review). Empirische Überprüfung der Struktur von motorischen Basiskompetenzen im Schulsport.

Physical activity and motivation

Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2010). Fundamental Movement Skills in Children and Adolescents: Review of Associated Health Benefits. *Sports Medicine*, 40(12), 1019–1035.

Robinson, L. E., Stodden, D. F., Barnett, L. M., Lopes, V. P., Logan, S. W., Rodrigues, L. P., & D'Hondt, E. (2015). Motor Competence and its Effect on Positive Developmental Trajectories of Health. *Sports Medicine*, 45(9), 1273–1284.

Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A Developmental Perspective on the Role of Motor Skill Competence in Physical Activity: An Emergent Relationship. *Quest*, 60, 290–306.

Title:

Überzeugungen Sport unterrichtender Lehrpersonen im Kontext migrationsbedingter Heterogenität

Authors/Affiliation:

Jonas Steiger
Eidgenössische Hochschule für Sport Magglingen EHSM

Abstract:

Schulen sind heute mit einem zunehmenden Anteil migrationsbedingt hetero-gener Schulklassen konfrontiert. Schülerinnen und Schüler mit unterschiedli-chen Muttersprachen, mit verschiedenen kulturellen Hintergründen und damit ungleichen Sozialisationserfahrungen prägen das Bild aktueller Schulklassen. Gefordert wird eine chancengerechte Schule, in welcher der Bildungserfolg einzelner Schülerinnen und Schüler nicht auf Stereotypen, verzerrten Erwar-tungen oder Diskriminierungen basiert (vgl. Schweizerische Koordinationsstel-le für Bildungsforschung [SKBF], 2014). Zudem ist „Umgang mit Vielfalt" als fächerübergreifendes Ausbildungsziel zum festen Bestandteil aktueller Schul-lehrpläne geworden (Deutschschweizer Erziehungsdirektoren-Konferenz [D-EDK], 2016). Auf Unterrichtsebene entsprechen diese bildungspolitischen Forderungen vor allem einem gestiegenen Anspruch an das Lehrerhandeln, dem viele Lehrpersonen nicht gerecht werden können. So geht aus verschie-denen Studien hervor, dass sich Lehrpersonen migrationsbedingt heterogener Klassen oft verunsichert oder gar überfordert fühlen (vgl. u.a. Edelmann, 2008; Grimminger, 2009). Verschiedene Analysen aus dem deutschsprachigen Raum zeigen zwar, dass Curriculuminhalte interkultureller Pädagogik zuneh-mend zu einem verpflichtenden Bestandteil der Lehrerausbildung geworden sind. In der Konzeption und in der Art der Implementierung in das Curriculum bestehen allerdings nach wie vor grosse Unterschiede (vgl. Buholzer, Zulliger & Zutavern, 2016; Sieber, 2009). Es ist deshalb nicht weiter erstaunlich, dass im Umgang mit migrationsbedingter Heterogenität subjektive Überzeugungen von Lehrpersonen – verstanden als eine eng an individuelle (Schul-)Erfahrungen gebundene Wissensform (vgl. Reusser & Pauli, 2014) – dominie-ren. Angesichts der in der aktuellen Lehrerkompetenzforschung postulierten zentralen Rolle von Überzeugungen und (Wert-)Haltungen von Lehrpersonen für die Qualität ihres Berufshandelns stellt sich mit Blick auf einen angemes-senen Umgang von Lehrpersonen mit migrationsbedingter Heterogenität damit jedoch umso mehr die Frage nach deren diesbezüglichen Überzeugungen. Bislang existieren nur wenige Forschungsarbeiten, die sich dieser Fragerich-tung angenommen haben (vgl. u.a. Hachfeld, 2012). Gänzlich unerforscht blieben dabei Lehrüberzeugungen im Kontext migrationsbedingter Heterogeni-tät, die einen konkreten Fachbezug aufweisen. Hier wurde mit dieser Untersu-chung explorativ angesetzt: Untersucht wurden die Überzeugungen über ein-zelne Schülerinnen und Schüler sowie die Überzeugungen über das Fach. Bezogen auf den Kontext der migrationsbedingten Heterogenität wurden dar-aus folgende zwei Fragestellungen abgeleitet:

1. Welche Vorstellungen über Schülerinnen und Schüler mit Migrationshin-tergrund im Sportunterricht haben Sport unterrichtende Lehrpersonen?
2. Welche Auffassungen zum Potenzial des Fachs Sport für interkulturelles Lernen haben Sport unterrichtende Lehrpersonen?

Methode

Als Methode zur Erfassung der Überzeugungen der Lehrpersonen wurde die Repertory Grid Methode (Kelly, 1991) gewählt. Insgesamt wurden 26 Sport unterrichtende Lehrpersonen aus 19 verschiedenen Oberstufenschulen des Kantons Bern, die einen Anteil von mindestens 30% fremdsprachigen Schüle-rinnen und Schülern aufweisen, befragt. Jede Lehrperson wurde mithilfe zwei-er spezifisch auf die Forschungsfragen zugeschnittenen Repertory Grid In-strumenten während je ca. 90 Minuten befragt, so dass schliesslich 52 sog. Rohgrids als Grundlage der Datenauswertung resultierten. Die in den Roh-grids enthaltenen qualitativen Daten wurden mittels qualitativen Inhaltsanaly-sen (Jankowicz, 2004), die quantitativen Daten durch Berechnung von Dis-tanzmassen bzw. sog. similarity scores (Jankowicz, 2004) ausgewertet.

Ergebnisse

Die Analysen zeigen, dass fremdsprachige Schülerinnen und Schüler von den Lehrpersonen (in Bezug auf ihre Idealvorstellung eines Schülers / einer Schü-lerin) allgemein weniger positiv wahrgenommen werden als nicht-fremdsprachige Schülerinnen und Schüler. Die aufgrund von Schülervergei-chen zum Ausdruck gebrachten sog. persönlichen Konstrukte lassen sich da-bei insbesondere den Themen „Motivation/Interesse", „Engage-ment/Beteiligung", „Sportliche Leistungsfähigkeit" und „Mit Anderen" subsu-mieren. Die Ergebnisse in Bezug auf die zweite Fragestellung verweisen zu-nächst auf ein vielschichtiges Verständnis interkulturellen Lernens der Lehr-personen. Dem Sportunterricht wird dabei ein vergleichsweise hohes Potenzi-al für interkulturelles Lernen zugesprochen.

References:

Buholzer, A., Zulliger, S., & Zutavern, M. (2015). Lehrerinnen- und Lehrerbildung in der Schweiz. Einblicke zum Thema Heterogenität in der Lehrpersonenausbildung. In C. Fischer, M. Veber, C. Fischer-Ontrup & R. Buschmann (Eds.), Umgang mit Vielfalt. Aufgaben und Herausforderungen für die Lehrerinnen- und Lehrerbildung. Münster: Waxmann.

Deutschschweizer Erziehungsdirektoren-Konferenz (2016, Februar 29). Lehrplan 21. Grundla-gen. Heruntergeladen von http://dedke.lehrplan.ch/container/DEDKE_Grundlagen.pdf

Edelmann, D. (2008). Pädagogische Professionalität im transnationalen sozialen Raum. Eine qualitative Untersuchung über den Umgang von Lehrpersonen mit der migrationsbedingten Heterogenität ihrer Klassen (2. Aufl.). Zürich: LIT Verlag.

Grimminger, E. (2009). Interkulturelle Kompetenz im Schulsport. Evaluation eines Fortbil-dungskonzepts. Baltmannsweiler: Schneider Verlag.

Hachfeld, A. (2012). Multikulturelle Überzeugungen. Herkunft oder Überzeugung? Welche Rol-le spielen der Migrationshintergrund und multikulturelle Überzeugungen für das Unterrichten von Kindern mit Migrationshintergrund? Zeitschrift für Pädagogische Psychologie, 26(2), 101-120.

Jankowicz, D. (2004). The Easy Guide to Repertory Grids. Chichester, UK: John Wiley & Sons Ltd.

Kelly, G. A. (1991). The psychology of personal constructs (Bd. 1, A theory of personality). London: Routledge.

Reusser, K., & Pauli, C. (2014). Berufsbezogene Überzeugungen von Lehrerinnen und Leh-rern. In E. Terhart, H. Bennewitz & M. Rothland (Hrsg.), Handbuch der Forschung zum Leh-rerberuf(2., überarbeitete und erweiterte Aufl.). Münster: Waxmann.

Sieber, P. (2009). Interkulturelle Pädagogik in der Lehrerinnen und Lehrerbildung. vpod-bildungspolitik, 164, 11-14.

SKBF (2014). Bildungsbericht Schweiz 2014. Aarau: Schweizerische Koordinationsstelle für Bildungsforschung.

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Motor learning and control

Title

Strukturelles Bewegungslernen und explorierte Aufgabenräume - Entwicklung und Erprobung einer mehrdimensionalen, seriellen Positionierungsaufgabe

Authors/Affiliation

Balthasar Hofer[1], Ernst-Joachim Hossner[1], Ralf Kredel[1]

[1]Institut für Sportwissenschaft, Universität Bern, Bern, Schweiz

Abstract

Einleitung

Strukturelles motorisches Lernen wurde bisher primär über das Studium einzelner Metaparameter untersucht. Wird der Lernprozess so gestaltet, dass die zugrundeliegende Aufgabenstruktur exploriert wird, ergeben sich daraus u.a. Vorteile im Umgang mit interferierenden Aufgaben oder beim Auffinden neuer Parameterkonfigurationen zur Lösung ähnlicher Aufgaben, die als Transfereffekte beschrieben werden (z.B. Braun, Aertsen, Wolpert & Mehring, 2009). Zur Erklärung komplexer motorischer Bewegungsaufgaben, wie sie etwa im Sport auftreten, sind Aufgabenstrukturen mit mehrdimensionalen Metaparametern notwendig. Um das Lernen solch komplexerer Aufgabenstrukturen im Laborsetting abbilden zu können, wurde eine neue Untersuchungsmethodik entwickelt, die im Rahmen der vorliegenden Studie zur Untersuchung von strukturellen Transfereffekten angewendet wurde. Konkret wurde erwartet, dass der Vernetzungsgrad zwischen zwei unabhängigen Aufgabenstrukturen durch einen variablen Lernprozess (hohe Wechselfrequenz) gesteigert wird, was sich im Vergleich zu einem geblockten Lernprozess (tiefe Wechselfrequenz) in einer höheren Transferleistung auf eine aus den beiden Aufgabenstrukturen kombinierte Struktur widerspiegeln sollte.

Methoden

Über 240 Übungsversuche hinweg wurde von den teilnehmenden Berner Sportstudierenden (n = 24, 50% ♀, M(Alter) = 22.0 ± 1.6 Jahre) eine computerisierte zweidimensionale Kreuz-Positionierungsaufgabe erlernt. Bewegungen des Cursor-Kreuzes wurden durch ein geschwindigkeitsbasiertes System mit 16 Eingangsdimensionen definiert, die von vier über die linken und rechten Zeige- und Ringfinger angesteuerten Kraft-Moment-Sensoren erfasst wurden. Im Detail bestand die Aufgabe darin, das Cursor-Kreuz mit einem stationären Ziel-Kreuz zu überlagern, wobei nach erfolgreicher Überlagerung in serieller Abfolge stets ein neues Ziel-Kreuz auf dem Monitor erschien. Die 16-dimensionale Aufgabenstruktur wurde für die Aneignungsphase in zwei voneinander unabhängige 8-dimensionale Aufgabenstrukturen unterteilt. In der Kontrollgruppe (n = 12, 50% ♀) wurden die beiden Aufgabenstrukturen geblockt geübt, wobei nach jeweils 60 erfolgreichen Überlagerungen die Aufgabenstruktur wechselte. Die Experimentalgruppe lernte die beiden Aufgabenstrukturen im Wechsel nach jeweils 6 erfolgreichen Überlagerungen. Im Transfertest (mit 6 Testversuchen) kam eine Kombination der beiden geübten 8-dimensionalen Aufgabenstrukturen in einer 16-dimensionalen Aufgabenstruktur zur Anwendung. Die Leistung im Transfertest wurde über die zwei Effizienzmasse *Geschwindigkeit* (Zieldistanz/Zeit) und *Pfadlänge* (Zieldistanz/Wegstrecke) quantifiziert.

Resultate

Im Transfertest zeigte die Experimentalgruppe signifikant bessere Leistungen sowohl für *Geschwindigkeit*, $t(22)$ = 2.23, p = .02, als auch für *Pfadlänge*, $t(22)$ = 1.78, p = .04, verbunden mit einem grossen, d = 0.91, bzw. mittleren Effekt, d = 0.73 (jeweils einseitige Testung).

Diskussion

Die Befunde deuten darauf hin, dass sich beim Neulernen zweier unabhängiger Aufgabenstrukturen ein höherfrequenter Aufgabenwechsel in einer ausgeprägteren Vernetzung der zugrundeliegenden motorischen Kontrollstrukturen niederschlägt, welche sich empirisch in höheren Transferleistungen in der kombinierten Aufgabe zeigt. In Bezug auf die in der Sportpraxis oft zur Anwendung kommende methodische Übungsreihe würde dies bedeuten, dass einzelne funktionelle Elemente einer Bewegung zwar durchaus isoliert erworben werden können, dass dieser Erwerb im Gesamtlernprozess allerdings im häufigen Wechsel mit dem Erwerb anderer Funktionselemente stehen sollte.

14

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Motor learning and control

References

Braun, D. A., Aertsen, A., Wolpert, D. M., & Mehring, C. (2009). Motor task variation induces structural learning. *Current Biology*, *19*, 352-357.

Motor learning and control

Title
Learning an interference task with either hand disrupts early motor memory consolidation bilaterally

Authors/Affiliation
Jan Ruffieux[1], Martin Keller[1], Wolfgang Taube[1]
[1]Movement and Sport Sciences, University of Fribourg, Fribourg, Switzerland

Abstract
Introduction
One of the most impressive features of the human nervous system is the capability to learn and memorize new motor skills. Practice of a new motor skill leads to performance improvements which can last for several hours or days after practice. The basis for such lasting motor learning effects lies in the conversion of the newly acquired motor memories from an initially unstable to an increasingly stable state – a neural process known as memory consolidation (Brashers-Krug, Shadmehr, & Bizzi, 1996). In an early study on motor memory consolidation, Brashers-Krug and colleagues (1996) showed that if a second motor skill is learned immediately after the first, consolidation is disrupted. This phenomenon is known as retrograde interference. However, this interference effect diminished gradually over time and was no longer present if four hours elapsed between learning the two motor tasks suggesting that disruption of consolidation is time-dependent (Brashers-Krug et al., 1996). Furthermore, there was no interference if the second task was not a learning task (Brashers-Krug et al., 1996). The findings of Brashers-Krug and colleagues (1996) have been confirmed and expanded in a later study by Lundbye-Jensen and colleagues (Lundbye-Jensen, Petersen, Rothwell, & Nielsen, 2011). They observed interference in the consolidation of a practiced ballistic motor task if it was followed by subsequent learning of a visuomotor tracking task. In line with the previous findings, interference did not occur from a non-learning task or if the second task was learned four hours after the first. Interestingly, also subsequent learning of a task involving the muscles antagonistic to the ones used in the first task, did not lead to interference (Lundbye-Jensen et al., 2011). Taken together, these studies suggest that motor interference is time-dependent, requires competing learning, and is muscle- and/or direction-specific.

Another interesting observation in motor learning is that practice of a motor skill with one limb can lead to improvements also in the untrained contralateral limb (Lee & Carroll, 2007). This phenomenon, known as bilateral transfer, has been shown for a large variety of motor skills over the past century (Lee & Carroll, 2007). There are two categories of theories explaining bilateral transfer effects. The first – the bilateral access hypothesis – suggests that adaptations occur essentially in motor areas that are involved in the control of the trained limb but are also accessible to the untrained limb during task performance (Lee & Carroll, 2007). According to the second theory – the cross-activation hypothesis – unilateral practice activates both hemispheres resulting in bilateral neural reorganization of task-specific motor circuits (Lee & Carroll, 2007; Parlow & Kinsbourne, 1989). The cross-activation hypothesis is supported by observations of bilateral brain activity or bilaterally increased corticospinal excitability during unilateral motor performance (Carroll, Lee, Hsu, & Sayde, 2008; Lauber et al., 2013; Lee, Hinder, Gandevia, & Carroll, 2010). Further support for the cross-activation hypothesis comes from a study that applied repetitive transcranial magnetic stimulation (rTMS) to induce a virtual lesion to the motor cortex (Lee et al., 2010). In this study, unilateral practice of a ballistic finger abduction task lead to bilateral performance improvements. Subsequent rTMS over either the left or the right motor cortex specifically reduced performance gains only for the respective contralateral finger suggesting that processes within the motor cortex ipsilateral to the trained side contribute to the transfer of performance gains to the untrained side (Lee et al., 2010).

A study, which combined the two phenomena of motor learning interference and bilateral transfer, found that not only performance improvements but also interference due to subsequent learning of different motor skills is transferred to the untrained limb (Lauber et al., 2013). Although it is known that bilateral transfer is often asymmetrical (usually with better transfer from the dominant to the non-dominant limb than vice-versa; Lee et al., 2010; Parlow & Kinsbourne, 1989), no study has to date investigated the effect of performing an interference task with the non-dominant limb. Therefore, the aim of the present study was (a) to replicate previous findings (Lauber et al., 2013; Lundbye-Jensen et

16

Motor learning and control

al., 2011) and (b) to complement them with knowledge about the effect of a subsequent learning task performed with the non-dominant limb on bilateral motor memory consolidation. For this purpose, we measured performance improvements and bilateral transfer in a ballistic motor task after practicing it with the dominant hand as well as bilateral performance in a retention test after a subsequent visuomotor tracking task that was performed either in the same or in the opposite direction compared to the first task with either the dominant or the non-dominant hand.

Methods

48 healthy young adults (20-35 years old) were randomly allocated to one of four groups. They all practiced a ballistic motor task – task A – involving the wrist flexors of their dominant hand. Performance improvements in the trained, dominant as well as bilateral transfer to the untrained, non-dominant hand were assessed. Immediately after completion of practice, participants learned a visuomotor tracking task – task B. According to the group, this task B was performed using the wrist flexors or extensors of the dominant hand (groups 1 and 2, respectively) or the non-dominant hand (groups 3 and 4, respectively). The effect of learning task B on bilateral performance in task A was assessed in a retention test immediately afterwards. The effects of practicing tasks A and B on bilateral performance in task A were evaluated with three-way mixed design analyses of variance (ANOVAs) with the factors group, hand, and time (before and after practice of tasks A and B, respectively). Improvements in task B were evaluated with a two-way mixed design ANOVA (group by time).

Results

Baseline performance in the ballistic task was on average 7.3 % lower with the non-dominant than with the dominant hand ($p < 0.001$). For the effect of practicing task A, a significant time effect ($p < 0.001$), in the absence of any interaction with group or hand (all $p > 0.46$), indicates that practicing the ballistic task with the dominant hand lead to similar improvements in all groups and in both the trained, dominant (+ 19.0 %) as well as the untrained, non-dominant hand (+ 17.0 %). Thus, there was complete bilateral transfer of the training improvements. For the tracking task, a significant group effect ($p = 0.037$) suggests that the groups performing the task with the extensors (groups 2 and 4) performed worse than the flexor groups. However, Bonferroni-corrected post hoc pairwise comparisons between the groups showed no significant differences. More importantly, a significant effect of time ($p < 0.001$) that did not interact with group ($p = 0.159$) indicates that all groups improved to a similar extent in the tracking task (33.3 % on average). Analysis of the effect of practicing task B on performance in task A showed a significant interaction effect of time and group ($p = 0.002$), indicating group differences in the effect of the tracking task on consolidation of the ballistic task. The absence of a significant interaction with the factor hand suggests that the latter effect was similar in the dominant and the non-dominant hand. Post hoc tests revealed significant and similar interference (- 7.6 %, $p < 0.001$) in the groups who performed task B with the flexors (groups 1 and 3) while the other two groups showed slight but nonsignificant improvements (+ 4.1 %, $p = 0.130$).

Discussion/Conclusion

In line with previous interference studies (Lauber et al., 2013; Lundbye-Jensen et al., 2011), we found that motor memory consolidation was disrupted bilaterally if participants engaged in subsequent learning of different motor skills that involved the same muscles of the trained, dominant limb but not if the second task was performed with the antagonistic muscles. This study is the first to show that learning a task B with the non-dominant hand, which did not practice task A, also disrupted memory consolidation of task A bilaterally. Again, this was only true if task B was performed with the muscles homologous to the ones trained and tested in task A. Interestingly, learning task B with the trained, dominant or the untrained, non-dominant hand disrupted memory consolidation to a similar extent, both for the trained and the untrained hand, as evidenced by similar decreases in performance in the retention task. If we come back to the different theories explaining bilateral transfer, our results fit well with the cross-activation hypothesis. Accordingly, unilateral learning of both tasks, A and B, would, irrespective of the hand with which it is learned, activate and provoke processes of neural reorganization within both hemispheres and thus also cause interference in both hemispheres if the two tasks are learned in close temporal proximity. According to the bilateral access models, which postulate that neural adaptations to learning occur mainly in motor areas of the "trained" hemisphere, learning a second task with one hand would not, or to a much lesser extent, interfere with performance in a task previously learned with the other hand – at least performance of the dominant hand would

not be disrupted by subsequent learning with the non-dominant hand. Therefore, together with the previous findings mentioned above (Carroll et al., 2008; Lauber et al., 2013; Lee et al., 2010), our results support the cross-activation hypothesis to explain bilateral transfer – at least for the type of tasks used in this study. It is, however, important to recognize that the two hypotheses are not mutually exclusive (Lee et al., 2010).

In summary, we present evidence that early motor memory consolidation of a task practiced unilaterally is disrupted in both hemispheres if a different motor skill engaging homologous muscles is learned immediately afterwards – irrespective of the hand with which it is performed. This suggests that unilateral motor learning provokes neural reorganization in both hemispheres.

References

Brashers-Krug, T., Shadmehr, R., & Bizzi, E. (1996). Consolidation in human motor memory. Nature, 382(6588), 252-255. doi:10.1038/382252a0

Carroll, T. J., Lee, M., Hsu, M., & Sayde, J. (2008). Unilateral practice of a ballistic movement causes bilateral increases in performance and corticospinal excitability. J Appl Physiol (1985), 104(6), 1656-1664. doi:10.1152/japplphysiol.01351.2007

Lauber, B., Lundbye-Jensen, J., Keller, M., Gollhofer, A., Taube, W., & Leukel, C. (2013). Cross-limb interference during motor learning. PLoS One, 8(12), e81038. doi:10.1371/journal.pone.0081038

Lee, M., & Carroll, T. J. (2007). Cross education: possible mechanisms for the contralateral effects of unilateral resistance training. Sports Med, 37(1), 1-14.

Lee, M., Hinder, M. R., Gandevia, S. C., & Carroll, T. J. (2010). The ipsilateral motor cortex contributes to cross-limb transfer of performance gains after ballistic motor practice. J Physiol, 588(Pt 1), 201-212. doi:10.1113/jphysiol.2009.183855

Lundbye-Jensen, J., Petersen, T. H., Rothwell, J. C., & Nielsen, J. B. (2011). Interference in ballistic motor learning: specificity and role of sensory error signals. PLoS One, 6(3), e17451. doi:10.1371/journal.pone.0017451

Parlow, S. E., & Kinsbourne, M. (1989). Asymmetrical transfer of training between hands: implications for interhemispheric communication in normal brain. Brain Cogn, 11(1), 98-113.

HCI J4: Sport science applied to professional and elite sport - Schneesport Forschung

Motor learning and control

Title

Cortical and spinal presetting to counteract translational and rotational perturbations

Authors/Affiliation

Michael Wälchli[1], Craig Tokuno[2], Jan Ruffieux[1], Martin Keller[1], Wolfgang Taube[1]

[1]Department of Medicine, Movement and Sport Sciences, University of Fribourg, Bd de Pérolles, 1700 Fribourg, Switzerland

[2]Department of Kinesiology, Brock University, St. Catharines, Ontario, Canada

Abstract

Introduction

Postural responses on expected perturbations are prepared anticipatorily (i.e. central set; Horak et al., 1989). Changes in cortical activation assessed by EEG prior to perturbations showed that central set is – at least partly – cortically mediated (Jacobs et al., 2008). However, little is known about the way the central nervous system prepares postural reactions to anticipated perturbations. To investigate this, subjects were exposed to translational and rotational perturbations in both anticipated (blocked) and unanticipated (random) conditions. Anticipatory preparation was assessed by electrophysiological methods briefly before perturbations. We hypothesized that only in blocked designs participants are able to make anticipatory adjustments.

Methods

Fifteen adults were exposed to four different perturbation conditions: 1) rotation (ROT), 2) translation (TRA), 3) random involving ROT and TRA (RAN), 4) static without perturbation (STA). After an acoustic cue, anticipatory preparation was measured by evoking H reflexes, motor evoked potentials (MEP), and short-interval intracortical inhibition (SICI) shortly before onset of perturbation in m. soleus (SOL) and m. tibialis anterior (TA). In some trials, no stimulation was applied (CON). Postural responses after perturbations were analyzed in CON trials only and were fragmented into short-latency responses (SLR; 30-60ms), medium-latency responses (MLR; 60-85ms), and long-latency responses (LLR; 85-120ms) for SOL and a late time frame for TA (120-200ms).

Results

Anticipatory H reflexes were different between conditions ($p = .023$) with higher values in TRA compared to ROT ($p = .037$). Peak-to-peak MEP values were similar for SOL but not for TA ($p < .001$) where STA was smaller than the three perturbed conditions. Main effects for SICI have been found for SOL ($p < .001$) and TA ($p < .001$) with more inhibition in STA compared to the other conditions. No adaptations have been detected for SLR and MLR in either ROT or TRA. The LLR was decreased in ROT ($p = .002$) and increased in TRA ($p = .046$) compared to the respective perturbation form in RAN. In TA, muscular activity was reduced in both blocked conditions compared to the equivalent RAN perturbations with significant differences in ROT only ($p = .004$).

Discussion/Conclusion

The unaltered MEP sizes in SOL demonstrated that anticipatory preparation in higher brain centers is not controlled within direct corticospinal pathways. More likely, anticipatory preparation state is modulated by intracortical connectivity as SICI was reduced when participant expected a perturbation. Furthermore, the anticipatory H reflex was correctly adapted by decreasing in ROT and enhancing in TRA, as SOL stretch reflexes are detrimental in rotations and beneficial in translations. However, no cortical or spinal adjustments were seen in preparation state between blocked and randomized perturbations.

The comparison of blocked and randomized perturbation reactions revealed unchanged SLR and MLR sizes. This indicates that preparation state is not affecting spinal reflexes. In contrast, the LLR was properly adapted when the perturbation could be anticipated. Thus, anticipatory preparation and spinal reflex circuits were not adjusted by central set, whereas the cortically mediated LLR is sensitive to central set.

Motor learning and control

References

Horak, F. B., Diener, H. C., & Nashner, L. M. (1989). Influence of central set on human postural responses. J Neurophysiol, 62(4), 841-853.

Jacobs, J. V., Fujiwara, K., Tomita, H., Furune, N., Kunita, K., & Horak, F. B. (2008). Changes in the activity of the cerebral cortex relate to postural response modification when warned of a perturbation. Clin Neurophysiol, 119(6), 1431-1442.

La Suisse et le sport international au XXe siècle

La Suisse et le sport international au XXe siècle

Abstract

Introduction

Qualifée en 1906 de "reine des sports" par Pierre de Coubertin pour l'excellence de ses infrastructures d'été comme d'hiver, la Suisse va devenir au fil du XX siècle le centre administratif du sport international. C'est d'abord l'installation du siège du Comité international olympique à Lausanne en 1915, puis celui de la FIFA à Zurich en 1930, d'autres fédérations internationales sportives (FIS) en sortie de Seconde guerre mondiale et surtout à compter des années 1980. Pour le CIO en 1981, puis pour la FIFA, la Confédération a inventé un statut spécifique, extrêmement privilégié et protecteur : "organisation internationale non-gouvernementale de droit privé suisse".

Methods

L'hypothèse de travail est que la rencontre historique entre la Confédération helvétique et les FIS ne s'est pas construite seulement sur la centralité de la Suisse en Europe et sur les idéaux de paix portés par la Société des Nations installée à Genève en 1920, mais sur des proximités idéologiques : le cosmopolitisme des élites dirigeantes du sport mondial et l'internationalisme libéral des élites suisses, l'apolitisme prêté au sport et la neutralité diplomatique de la Confédération, le conservatisme et l'anti-communisme des uns et des autres. La Suisse n'a longtemps guère prêté d'intérêt à ces organisations jusqu'à en faire depuis les années 1980-1990 l'un des axes forts de sa diplomatie. À ses risques et périls quand ces institutions perdent leur exemplarité : scandale de Salt Lake City en 1999, "Fifagate" en 2015.

Les quatre interventions ici proposées couvrent toute la période historique en adoptant des grilles de lecture différentes :

- le *High Life* des présidents du CIO
- l'affichage démocratique des instances internationales du football
- l'engagement citoyen d'un journaliste sportif suisse contre le régime dictatorial argentin
- le statut fiscal et l'immunité des organisations internationales

Presentations

- Florence Carpentier, "Les présidents du CIO et la Suisse depuis 1915"
- Philippe Vonnard, "L'installation de la FIFA à Zurich (1930) et de l'UEFA à Berne (1960)"
- Grégoire Schneider, "Le *Mundial* argentin 1978 sous le regard d'un journaliste sportif romand: illustration d'une crise des valeurs du sport"
- Quentin Tonnerre, "L'octroi par la Confédération d'un nouveau statut juridique au CIO (1981)"

Discussion/Conclusion

La discussion pourra porter sur la longue absence de ces institutions dans le débat politique interne à la Suisse et sur le *soft power* sportif de la Suisse.

References

Carpentier, F. (2014). Les cultures corporelles et sportives des femmes au pouvoir, de Golda Meir à Angela Merkel. *Histoire@Politique*, 23 (2), 32-59

Clastres, P. (2008). *Jeux olympiques. Un siècle de passions*. Paris: Les Quatre Chemins.

Nye J. S. (2004). *Soft Power. The Means to Success in World Politics*. New York: Public Affairs.

Vonnard P., Quin G., Bancel N., eds. (2016). ***Building Europe with the Ball : Turning Points in the Europeanization of Football, 1905-1995***. Berne: Peter Lang.

Sugden, J. & Tomlinson, A. (1998). *FIFA and the Contest for World Football: Who Rules the Peoples' Game*. Cambridge: Polity.

21

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

La Suisse et le sport international au XXe siècle

Authors/Affiliation

Carpentier Florence

Université de Rouen, CETAPS (EA 3832), France

Abstract

Pendant l'entre-deux-guerres, les membres du CIO sont cooptés parmi l'élite sociale européenne : l'aristocratie et la haute-bourgeoisie des affaires, de la politique, de la diplomatie ou des armes. La fortune est une condition implicite pour devenir membre, tant les déplacements sont nombreux pour s'investir dans l'organisation olympique. Tous les ans, les membres se réunissent en session, dans différents pays d'Europe de l'ouest et de sa périphérie. La Suisse, siège officiel du CIO depuis 1915, et Lausanne en particulier, d'où officie un secrétaire général depuis les années 1920, occupent une place singulière dans la vie très cosmopolite des membres du CIO. Alors qu'ils préfèrent plutôt se réunir annuellement dans d'autres pays, l'Helvétie reste un passage régulier pour beaucoup d'entre eux dans le cadre professionnel ou privé. Le secrétaire André Berdez ou le représentant olympique suisse Godefroy de Blonay, résidant à Yverdon, accueillent alors régulièrement ces visiteurs de la famille olympique.

Cette communication présentera plus largement le cadre des sessions annuelles du CIO. Ces réunions itinérantes, étalées sur une semaine, sont l'occasion pour les représentants olympiques de se déplacer parfois en famille, car les temps de travail côtoient des moments de tourisme et de festivité. Dans les archives du CIO, à Lausanne, les programmes officiels des sessions, la correspondance entre les membres, mais aussi les nombreuses photos prises chaque année permettent de retracer ces voyages mondains. Ainsi, le programme des visites culturelles permet de donner un aperçu des « incontournables » touristiques de chaque ville. Les nombreux banquets et réceptions rappellent les habitudes gastronomiques de cette élite sociale, mais montrent aussi combien ces voyages sont avant tout des moments de sociabilité et de renforcement d'un « capital social ». Enfin, les membres du CIO participent à de nombreuses fêtes locales et sportives, souvent organisées en leur honneur. En ce sens, les voyages du CIO réinventent un tourisme d'élite, affairiste et protocolaire, culturel et festif.

La Suisse et le sport international au XXe siècle

Title

Le *Mundial* argentin 1978 sous le regard d'un journaliste sportif romand: illustration d'une crise des valeurs du sport

Authors/Affiliation

Grégoire Schneider

Assistant-doctorant à Institut d'Histoire de l'Université de Neuchâtel, Suisse.

Abstract

Introduction

Ce travail présente le cas singulier de Raymond Pittet, journaliste sportif Vaudois, qui fut partie prenante de la tentative de boycott de la Coupe du Monde 1978 en Argentine Durant la dictature du Général Videla.

Methods

Au travers d'une plume reconnue dans l'espace francophone, Raymond Pittet a construit et livré une manière d'écrire le récit sportif. Homme de conviction, il s'est ainsi particulièrement distingué par sa prise de position face à la question d'un boycott du *Mundial* argentin. Même si la FIFA a toujours revendiqué vouloir éviter toute forme de politisation de son événement phare, force est de constater que la diffusion spatiale et sociale universelle du football possède des résonances identitaires très fortes dont la Junte militaire alors au pouvoir s'est certainement servie. Dans la relation complexe entre sport et politique, l'identification à des valeurs, tantôt rapproche, tantôt sépare ces deux domaines. Et aux yeux de Raymond Pittet, qui apparaît ici comme un témoin, ces valeurs sont en crise. Dans ce contexte, la Suisse, par ses différents acteurs, doit aussi prendre position. Et notre journaliste assumera la sienne –publiquement – malgré un statut qui le désignait pourtant comme l'un des chefs de fil de la délégation s'apprêtant à couvrir l'événement.

Results

Le parcours intellectuel, mais aussi sportif de Raymond Pittet doit permettre de mieux comprendre la valeur de son geste. Avec finesse et expertise, il réinvente en quelque sorte de journalisme sportif, proposant un angle plus sociologique et réflexif. Ainsi, il donne au « football des talus » ses lettres de noblesse, dans un esprit très proche de la mythologie sportive coubertinienne.

Dès lors, sa décision de ne pas assister à la Coupe du Monde 1978, pour les raisons que l'on sait, prend ici tout son sens et s'inscrit véritablement comme une expression personnelle de sa sensibilité. Sa conscience d'homme l'emporte sur les impératifs de son métier et la dimension de l'événement sportif en lui-même.

Discussion/Conclusion

Raymond Pittet fut l'un des seuls à refuser le voyage en Argentine et sa position reste tout à fait singulière dans le milieu médiatique. Il incarne ainsi une vision du sport romantique et littéraire, mais aussi peut-être une position propre à la Suisse, et plus particulièrement liée à des valeurs de son terroir, dont il se sent probablement un digne représentant, défendant son idéal dans le grand concert sportif mondial.

References

CONTAMIN Jean-Gabriel et LE NOE Olivier (2010), *La Coupe est pleine Videla ! Le Mundial 1978 entre politisation et dépolitisation*, in : Le Mouvement Social, janvier-mars 2010, Editions La Découverte, Paris, pp. 27-46.

DIETSCHY Paul et al. (2006), *Histoire politique des Coupes du Monde de footballI,* Vuibert, Paris.

FAURE Jean-Michel et SUAND Charles (1994), *Les enjeux du football*, In: Actes de la recherche en sciences sociales. Vol. 103 (juin 1994), pp. 3-6.

PITTET Raymond (1971), *Le football et les hommes*, Imprimeries Réunies SA, Lausanne.

PIVOT Bernard, *La passion du football*, in : Emission *Apostrophe*, n°145, le 12 mai 1978.

La Suisse et le sport international au XXe siècle

Title

L'octroi par la Confédération d'un nouveau statut juridique au CIO (1981)

Authors/Affiliation

Quentin Tonnerre

Université de Lausanne

Abstract

Introduction

Les relations entre le Comité international olympique et la Confédération helvétique, le Canton de Vaud et la Municipalité de Lausanne n'ont pas toujours été celles qu'on leur connaît aujourd'hui. D'abord marquées par le désintérêt des autorités suisses lors de l'installation de l'organisation en 1915 à Lausanne, puis de méfiance réciproque, elles ont peu à peu été améliorées par l'intermédiaire d'acteurs qui évoluent aux frontières des univers sportif et politique: membres suisses du CIO, chanceliers du CIO, personnalités politiques suisses, etc. Pour cela, ces élites dirigeantes ont construit un discours de convergence entre la neutralité suisse dans l'espace diplomatique et la culture politique d'apolitisme du CIO qui avait pour but de rendre « naturelle » sa présence en Suisse. La Confédération a ainsi décidé, en 1981, d'octroyer au CIO le statut d'organisation internationale non-gouvernementale de droit privé suisse.

Methods

Quelle a été l'influence exacte des acteurs précités ? En quoi cette opération a-t-elle servi à la fois les intérêts de la Confédération helvétique et ceux du CIO ? Pour répondre à ces questions, nous nous appuierons principalement sur des archives du Comité international olympique, provenant de son Centre d'études olympiques de Lausanne, et sur des documents issus des Archives fédérales à Berne, notamment de la Division des organisations internationales du Département politique fédéral. S'inscrivant plus généralement dans le thème du panel, notre travail fera l'hypothèse de proximités idéologiques entre les différents acteurs concernés, notamment en termes de cosmopolitisme des élites dirigeantes du sport mondial et d'internationalisme libéral des élites suisses.

Results

L'octroi d'un nouveau statut juridique au CIO marque un tournant dans la diplomatie sportive suisse. Reconnaissant que la présence en Suisse de cette organisation revêt un caractère particulier dans le cadre des relations extérieures de la Confédération, cette dernière va dès lors resserrer ses liens avec le CIO, en se mettant de plus en plus à son service. Dans la foulée, d'entente avec des acteurs sub-é-tatiques responsables de la paradiplomatie sportive, les autorités politiques suisses développent une nouvelle conception de l'utilisation du sport : celle d'un outil de *nation branding*.

Discussion/Conclusion

En conclusion, la reconnaissance par la Confédération du statut d'organisation internationale non-gouvernementale du CIO marque l'aboutissement du long processus de mise en place d'une diplomatie sportive en Suisse. Cette nouvelle étape aura entre autres pour conséquence une arrivée massive des fédérations internationales sportives sur le territoire helvétique dans les années 1990 et 2000.

References

Clastres, P. (2008). *Jeux olympiques. Un siècle de passions*. Paris : Les Quatre Chemins.

Hug, P.-A. (2001), De l'utopie au pragmatisme : l'installation du CIO à Lausanne (1906-1927). In Jaccoud, C., Busset, T., *Sports en formes. Acteurs, contextes et dynamiques d'institutionnalisation.* Lausanne : Antipodes.

Latty, F. (2001). *Le Comité international olympique et le droit international.* Paris: Editions Montchrestien.

Morath, P. (2000). *Le C.I.O. à Lausanne 1939-1999.* Yens sur Morges : Editions Cabédita.

La Suisse et le sport international au XXe siècle

Title

S'établir en Suisse. L'installation des autorités internationales du football dans la Confédération: les cas de la FIFA et de l'UEFA.

Authors/Affiliation

Philippe Vonnard[1], Grégory Quin[2]
[1]Institut des sciences de la communication du CNRS, Paris, France.
[1]Institut des sciences du sport de l'Université de Lausanne, Lausanne, Suisse.

Abstract

Introduction

La Suisse apparaît comme une terre d'accueil propice aux organisations internationales. Depuis les années 1910, le Comité international olympique a posé ses quartiers sur les bords du Léman. Cette décision a, par la suite, fait des émules, favorisée notamment par l'installation de la Société des Nations en 1919 à Genève. Cette situation est bien révélée dans le cas des organisations internationales de football puisque la Fédération internationale de football association (FIFA) s'implante à Zurich en 1931. Près de trente ans plus tard, c'est l'Union des associations européennes de football (UEFA) qui décide de se baser à Berne. Quelles raisons ont poussé ces deux organismes à venir s'installer en Suisse? Quels sont les avantages qu'offre la Confédération helvétique? Nous essaierons, dans cette communication, d'expliciter quelques „raisons évidentes" (centralité géographique, présence du CIO), pour paraphraser Pierre-Yves Saunier, mais aussi de discuter quelques pistes moins connues (moyen de communication, force du système bancaire, voire politique de la Confédération).

Methods

Nous disposons en Suisse de très riches fonds d'archives sportives, en particulier celle des organisations internationales sportives. Pour autant, ceux-ci n'ont jusqu'ici été que peu exploités. Pour ce projet, notre corpus se compose des documents officiels de l'UEFA et de la FIFA. Cette documentation est complétée par une lecture attentive de plusieurs journaux sportifs suisses (*Le Sport Suisse, La semaine sportive, Die Sport*) et français autour de l'installation du siège des deux organisations en Suisse. Enfin, et dans le but d'approfondir spécifiquement certains éléments, des entretiens ont été menés avec deux anciens secrétaires généraux de l'UEFA (P. Delaunay et H. Bangerter) ainsi qu'un journaliste de L'Equipe des années 1950 aux années 2000, Jacques Ferran.

Discussion

Le but de cette contribution est de poser des jalons historiques sur un sujet encore peu traité : celui de l'implantation des organisations sportives en Suisse dans la première moitié du siècle dernier. Ces bases doivent permettre de mieux comprendre comment la Confédération, au fil des années, se profile progressivement comme une terre d'accueil pour les organisations internationales. Plus globalement, cette proposition s'inscrit dans les récentes réflexions entamées, notamment à l'Université de Lausanne, autour du développement d'une « diplomatie par le sport » de la part du gouvernement helvétique.

References

Carpentier F. (2004), *Le comité international olympique sous la présidence de Henri de Bailet-Latour, successeur méconnu de Pierre de Coubertin 1925-1940*, Lille: A.N.R.T.

Eisenberg et al. (2004), *FIFA 1904-2004. Le siècle du football*, Paris : Le cherche midi.

Fleury A. (2003), « Genève : lieu de mémoire d'une Europe rêvée et de l'Europe des réalités », *in* Ghervas S., Guindani S. (dir.), *Penser l'Europe : quarante ans d'études européennes à Genève*, Genève : Université de Genève, pp. 89-96.

Herren M., Zala S. (2002), *Netzwerk Aussenpolitik: Internationale Kongresse und Organisationen als Instrumente der schweizerischen Aussenpolitik, 1914-1950*, Zurich: Chronos.

Morath P. (2000), *Le CIO à Lausanne*, Yens sur Morges: Ed. Cabédita.

La Suisse et le sport international au XXe siècle

Saunier P.-Y. (2012), « La secrétaire générale, l'ambassadeur et le docteur. Un conte en trois épisodes pour les historiens du "monde des causes" à l'époque contemporaine, 1800-2000 », *Monde(s)*, vol. 1, n° 1, pp. 29-46.

Biomechanics and kinematic analysis

Title

Relating Kinematic Error to Movement Variability Quantitatively by Using Dynamic Time Warping

Authors/Affiliation

Nicolas Gerig[1], Robert Riener[1], Peter Wolf[1]

[1] SMS Lab, ETH Zurich and Balgrist University Hospital, University of Zurich, Switzerland

Abstract

Introduction

When single movement outcomes are not sufficient to evaluate a movement, the entire movement can be compared to a reference movement. For the example of an unsuccessful golf put, instead of just considering the resulting distance from the ball to the golf hole, comparing the entire golf swing to a successful reference movement would provide more information to improve the golf put. For the example of rowing, the quality of a rowing stroke cannot be read out of a single outcome such as average boat velocity. Other factors such as energy efficiency to allow prolonged rowing sessions without fatigue should be considered. In addition, task related outcomes like average boat velocity are dependent on multiple movement repetitions. Therefore, reporting just an average boat velocity provides little information for the subject to improve the quality of rowing strokes, whereas comparisons to a reference movement may provide valuable information.

Performance of such movements (e.g. quality of rowing strokes) is challenging to evaluate, and obtaining an error measure by comparing the movements to successful reference movements (expert rowing strokes) is often the only known solution. Obtaining a variability measure by comparing repeated movements to each other with the goal to evaluate the subject's consistency is another application of movement comparison.

A quantitative comparison between movements can be based on measures of dissimilarity of the movements' underlying data, typically a time-series of kinematic or kinetic data. Thereby, a dissimilarity metric for time-series needs to be defined, which specifies a) the alignment of samples between the two compared time-series; b) the calculation of dissimilarity between these samples; and c) the derivation of a final measure out of these sample dissimilarities. Choosing a suitable dissimilarity metric is not trivial; the meaning of a dissimilarity metric does not only depend on the movement task, but also on the conditions the movement was recorded at.

A commonly used dissimilarity metric is the so-called instantaneous tracking error, where samples of movement and reference movement are aligned by fixed time, then the Euler distance between each movement sample and related reference sample is calculated, and finally the average of Euler distances is derived as a final measure of dissimilarity. Thereby, the instantaneous tracking error is well-suited for movement tasks displaying the own position and the reference always to the subject. However, the instantaneous tracking error will count temporal deviations such as delays rigorously as errors in space. Thereby, temporal deviations are overestimated compared to spatial deviations for movements, where absolute temporal accuracy is not required. Additionally, the instantaneous tracking error is rather unspecific for interpretation: From a reduction of instantaneous tracking error over time we cannot conclude if a subject improved spatial accuracy or just temporal similarity to reference.

Other dissimilarity metrics that base their alignment of samples in a more sophisticated way exist. For example, dissimilarity metrics can be realized using dynamic time-warping (Giese & Poggio, 2000) for optimal alignment of samples with respect to a cost function weighting temporal versus spatial errors. After such an alignment with dynamic time warping, the same Euler distance and average over samples can still be used to obtain a dissimilarity measure. In fact, dynamic-time warping is a quite general alignment, where the instantaneous tracking error can be realized as the case of having infinite temporal weighting in the cost function. Dissimilarity metrics based on dynamic time-warping may offer three major benefits for the evaluation: (1) setting of a desired speed accuracy trade-off, (2) isolation of spatial from temporal aspects, and (3) preservation of time continuity (Giese & Poggio, 2000).

If a suitable and reasonable dissimilarity metric is defined, not only dissimilarity to reference, i.e. the error, can be evaluated, but also the dissimilarity of multiple repetitions, i.e. movement variability.

Biomechanics and kinematic analysis

Movement variability should not be confused with the variance of the error. The variance of the error gives information on how consistent the subject can achieve a certain error, whereas the movement variability gives information on how consistent he executes movements. Different movements with the same dissimilarity to reference result in the same error, therefore even though there is movement variability, the variance of error would be zero. Movement variability could be of great value for the design of trainings: Subjects that perform bad, but consistently will probably benefit from different training strategies than subjects that are not able to execute consistent movements.

Since both error and variability are comparisons between movements they require a defined dissimilarity metric. For some simple dissimilarity metrics, variability might be calculated by comparing movement repetitions to an average movement. However, the definition of an average movement is specific to a defined dissimilarity metric and an average movement does not necessarily exist. A conceptually simpler solution to calculate variability, which works for every dissimilarity metric, is to compare each movement repetition to each other movement repetition.

Using the same dissimilarity metric to evaluate both error and movement variability results in quantitatively related outcomes that can directly be interpreted:

1) If average error to reference is equal or smaller than movement variability, the movement repetitions are more similar to reference than to each other. This indicates that the subject might be limited in achieving lower errors by his/her capability to perform consistent (with low variability).

2) If movement variability is much smaller than the average error, this might indicate that the subject has a bad knowledge of the reference movement, and/or that the subject is satisfied with his/her performance, and/or that limitations (e.g. physiological ones) are met on how accurate the subject can track the reference.

In the case that different dissimilarity metrics were used to obtain measures for error and movement variability such interpretations could only be done by normalizing with data from a typical reference subject or a balanced reference population, which are often not available.

Within this work we demonstrate how to evaluate kinematic error and movement variability using dissimilarity metrics based on dynamic time warping for trunk-arm rowing experiments.

Methods

In our rowing experiments, subjects were instructed to reproduce a reference rowing stroke as accurately as they can, while focusing on both spatial accuracy and the reference velocity profile. During the test conditions, subjects did not receive any temporal or spatial cues.

We evaluated the movement using two separate dissimilarity metrics, a spatial dissimilarity (horizontal and vertical oar angle) and velocity magnitude dissimilarity (angular change per second) using two independent dynamic time warping evaluations. Since the speed-accuracy tradeoff chosen by the rower was not observable, we have conservatively set zero temporal weighting to evaluate both spatial and velocity dissimilarity separately. By using a zero temporal weighting on dynamic time warping we eventually sacrificed sensitivity but obtained specificity, i.e. improvements in spatial error could not be based on increased temporal similarity to the reference movement. However, dynamic time warping with a zero temporal weighting still preserves time continuity, resulting in a dissimilarity metric sensitive to measure dissimilarities originating from unnecessary looping movements for example. Conventional purely spatial metrics (e.g. figural distance, the surface area between curves) are less sensitive to such movement errors since the sequence of samples is disregarded completely. Another benefit of our dissimilarity metrics is clarity: spatial dissimilarity and spatial variability are expressed in a measure with a spatial unit.

In our former rowing studies, no learning effects were observed after the first day of training, e.g. (Sigrist, Rauter, Marchal-Crespo, Riener, & Wolf, 2015). Whether subjects could further improve was unclear. Therefore, we reevaluated our best group of subjects. To obtain reference values for feasible movement variability, two expert rowers were instructed to perform trunk-arm rowing as consistent as they can. No statistics were performed due to low sample sizes; instead the range of data is reported.

Biomechanics and kinematic analysis

Results

TABLE 1	Error (n=8)	Variability (n=8)	Expert Variability (n=2)
Spatial	1.56-4.20 º	1.48-2.37 º	0.73-0.75 º
Velocity Magnitude	1.94-5.10 º/s	2.71-4.22 º/s	1.65-1.68 º/s

To illustrate spatial error and variability, Figure 1 presents the movements of two distinctly different
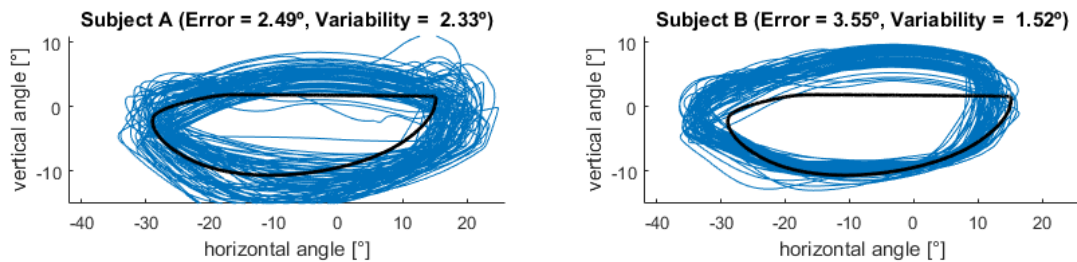

Figure 1: Spatial movements (blue) of two distinct subjects vs. reference (black) during a test condition.

subjects during a test condition. Subject A performed very similar in both error and variability, therefore was eventually bound by his capability to move consistently, whereas subject B showed more error to reference but yet moves more consistently.

Discussion/Conclusion

Comparing both spatial and velocity magnitude error to variability (TABLE 1) showed that most subjects were not yet limited due to their ability to perform consistent. Additionally, as subjects' variability was more than double of what experts achieved, subjects should still have the potential to improve their consistency.

As an outlook we want to investigate if we can achieve better performances by training subjects with feedback strategies that provide a higher resolution of reference information and reduce subjective satisfaction with personal performance. A promising approach combining both these aspects might be error augmentation, where the subjects' errors are artificially augmented before fed back to them.

References

Giese, M. A., & Poggio, T. (2000). Morphable models for the analysis and synthesis of complex motion patterns. International Journal of Computer Vision, 38(1), 59–73.

Sigrist, R., Rauter, G., Marchal-Crespo, L., Riener, R., & Wolf, P. (2015). Sonification and haptic feedback in addition to visual feedback enhances complex motor task learning. Experimental Brain Research, 233(3), 909–925. doi:10.1007/s00221-014-4167-7

Biomechanics and kinematic analysis

Title

Estimating air drag from dynamic pressure measurements for alpine ski racing

Authors/Affiliation

Nicolas Jacquemin[1], Benedikt Fasel[1], Jörg Spörri[2], Kamiar Aminian[1]

[1]Laboratory of Movement Analysis and Measurement, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Department of Sport Science and Kinesiology, University of Salzburg, Hallein-Rif, Austria.

Abstract

Introduction

In alpine ski racing, only a fraction of second can decide between winning and losing a race. Particularly in the speed disciplines (i.e. downhill and super-G), minimizing air drag might be an efficient way to enhance a skier´s performance (Gilgien, 2014). For example, Brownlie et al. (2010) reported that a 5.2% increase of the drag force can slow a skier by 0.19 s over 250 m of straight gliding section. Various other studies, mostly performed in wind channels, tried to find the aerodynamically optimal skiing posture and reported the "egg-shaped" posture to be the best (Federolf et al., 2008).

Air drag F_d is the force due to the air resistance on a body. It depends on the air density ρ, speed v, and body shape and surface structure described by the two parameters frontal area A and drag coefficient C_d. The frontal area is defined as the area the body covers in the plane normal to the velocity vector. The drag coefficient is a dimensionless parameter and is specific to each body shape. The drag force is described by equation 1.

$$F_d = 0.5\, C_d\, A\, \rho\, v^2 \qquad (1)$$

In order to determine the drag of a skier during races, each parameter in equation 1 can be estimated by different means. The air density can be determined by measuring the static barometric pressure and the temperature. The speed of the airflow is either directly measured in the wind tunnel or approximated by skiing speed for outdoor measurements (Reid, 2010; Meyer, 2012). The frontal area can be determined with a camera placed in front of the skier (Reid, 2010; Meyer, 2012). The drag coefficient is experimentally determined in wind tunnels where F_d can be measured directly using force plates. In-field experiments are often based on the drag coefficients determined in these wind tunnel studies (Reid, 2010).

For wind tunnel measurements, Spring et al. (1988) reported a drag area ($C_d * A$) of 0.27 ± 0.03 m^2 in a semi-squatting posture and 0.65 ± 0.05 m^2 in an upright posture for speeds between 5 and 11 m/s. Watanabe and Ohtsuki (1977) measured a drag between 11.76 N (at 10 m/s) and 256.27 N (at 30 m/s). Thompson and Friess (2001) determined a drag coefficient (C_d) of 0.15 to 0.167 for speed skiers at a speed of 220 km/h. For outdoor conditions during slalom skiing Reid (2010) modelled air drag and obtained a maximum average drag of 85 ± 8 N, occurring during the first half of a turn cycle.

Wind tunnels experiments give reliable results when trying to optimize a static posture. However, dynamically changing skiing postures are more complicated to simulate. It is therefore challenging to transfer the findings form wind tunnel tests to in-field conditions, as the optimal position determined in the wind tunnel cannot be kept during the whole race.

Biomechanics and kinematic analysis

In this work, the first aim was to design and validate a new method to approximate the air drag force. The hypothesis was that the air drag force would be related to the dynamic barometric pressure distribution over the athlete's body. Provided enough measurement points, the air drag could then be estimated based on the measured barometric pressure. A second aim was to numerically simulate more postures and wind speeds based on a simplified model of the athlete.
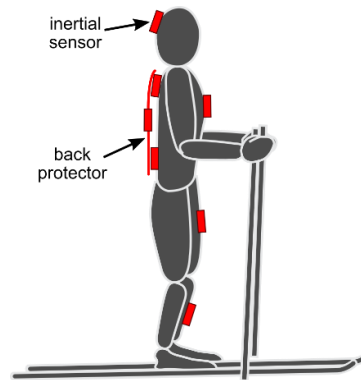

Figure 2: Position of the sensors

Methods

Setup and measurement: Seven inertial sensors containing additionally a barometric pressure sensor (Physilog 4, Gait Up SA, Switzerland) were placed on the athlete, using a custom made underwear suit. The sensors were fixed to the left shank and thigh, sacrum, sternum, C7, and head. An additional sensor was inserted in the athlete's back protector (figure 1). In the wind tunnel, for one athlete three different postures (optimal, optimal with elbows outside knees, half upright) and five different wind speeds between 70 and 110 km/h were recorded (figure 2). To ensure static condition each trial lasted 20 seconds. A force plate was used to obtain the reference air drag.
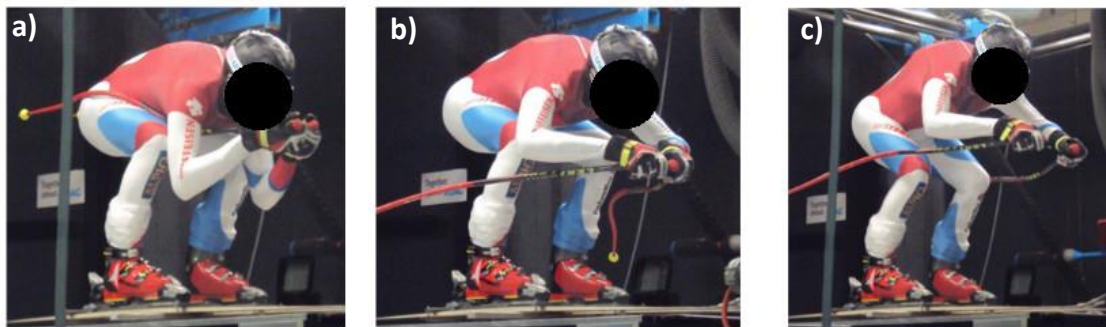

Figure 3: Postures tested in wind tunnel a) Optimal, b) Optimal with elbows outside knees, c) Half upright

Scenario A: For each sensor the dynamic air pressure was computed as the difference between measured barometric pressure and the static pressure of the wind tunnel. For each trial, data was then averaged over two second windows, resulting in 10 data points per trial. All conditions were pooled together and Pearson's linear correlation coefficient was computed between the dynamic pressures of each sensor location and total air drag (significance level of 0.05). Sensor locations with an absolute correlation coefficient above 0.75 were then selected to fit a linear regression model for estimating the total air drag force.

Scenario B: A 3D model imitating the skier's posture (figure 3) was created with Solidworks (Dassault Systèmes, France). The wind tunnel conditions were then simulated with ANSYS Fluent (ANSYS, Inc., USA). Virtual pressure sensors were placed at the same places as the inertial sensors. Obtained were dynamic pressures for each simulated sensor position. Offset and sensitivity of all simulated values were corrected to match the units of the measured reference data from the wind tunnel. The same regression model developed in the previous section was then applied to estimate total drag.

Biomechanics and kinematic analysis

The estimated air drag from both, the measured and the simulated setup, was compared to the reference air drag obtained from the wind channel. Differences between both setups and the reference were defined as the estimation error. The accuracy was defined as the mean error and the precision as the standard deviation of the error.
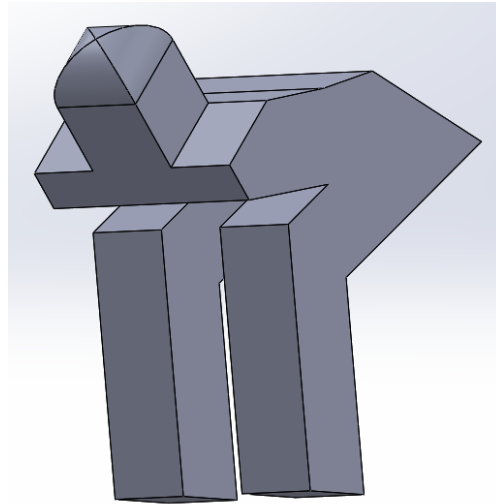

Figure 4: Simplified body model in optimal posture

Results

Dynamic pressure was significantly correlated to total air drag for the sensors fixed to the sacrum, head, C7, and back protector. The Bland-Altman plot of scenario A is displayed in figure 4. Accuracy was 0.01 N and precision 2.3 N (4%). The Bland-Altman plot of scenario B is presented in figure 5. For this experiment, the accuracy was 0.1 N and the precision 6.0 N (8.5%). For all the experiments, the error was independent from the measured value.
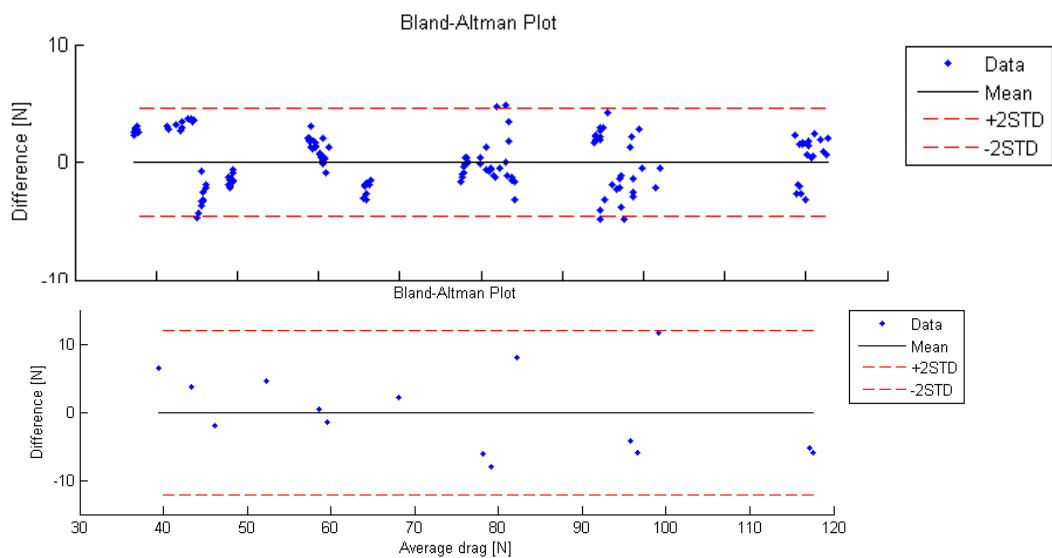

Figure 5: Bland-Altman Plot of scenario B

Discussion/Conclusion

A linear regression model based on the measured barometric pressure and a numerical simulation were designed in this study to estimate air drag of a skier. The approaches were compared to wind tunnel measurements on three postures of one athlete. Total air drag of the skier could be estimated in all cases. The obtained errors were comparable to previous wind tunnel studies that present results with a precision of around 8 to 10% (Spring et al., 1988), or even 12.5% (Thompson and Friess, 2001).

In order to better understand why dynamic pressure was able to precisely estimate air drag, equation 1 can be rewritten as follows:

$$F_d = C_d A P_{dyn} \qquad (2)$$

where $P_{dyn} = 0.5 \rho v^2$. For a given posture, $C_d A$ remains constant and only P_{dyn} is changing, depending on the speed. If we would divide the body in smaller segments, total drag would be the sum of the drag of each individual segment. If the proposed regression model is interpreted following the same logic, then the regression coefficients are equal to $C_d A$ for each individual segment. If this hypothesis is confirmed, this would help to assess that the model is working for any posture. So far, it is proved to be working on the three postures. However, it will be important to assess whether the model is still working with other postures, as the model might be overfitted for these particular three postures.

All the statistically significant pressures are located on the back of the athlete's trunk. For the measured postures, it seemed that the pressures on the legs might have less effect. This might be because the legs are thinner and are therefore producing less drag compared to the trunk. However, again, it might be important to assess whether these findings are generalizable to other than the analyzed postures as well. Another drawback of this study might be the fact that only one athlete was measured. As the corpulence of the athlete could affect the drag, the method should further be validated on other athletes.

The results of this study indicate that it might be possible to detect relevant air drag differences based on dynamic pressures. The method´s precision was observed to be smaller than the drag differences between two different speeds or two different postures. The model could be used to determine air drag during on-snow training and over an entire course. Moreover, by future efforts even a real-time feedback application for on-snow training might become feasible.

Acknowledgements

References

Brownlie, L., Larose, G., D'Auteuil, A., Allinger, T., Meinert, F., Kristofic, P., & Stephens, D. (2010). Factors affecting the aerodynamic drag of alpine skiers. *Procedia Engineering*, 2(2), 2375-2380. doi:10.1016/j.proeng.2010.04.002

Federolf, P., Scheiber, P., Rauscher, E., Schwameder, H., Lüthi, A., Rhyner, H., & Müller, E. (2008). Impact of skier actions on the gliding times in alpine skiing. *Scandinavian Journal of Medicine & Science in Sports*, 18(6), 790-797. doi:10.1111/j.1600-0838.2007.00745.x

Gilgien, M. (2014) Characterization of Skiers' Mechanics, Course Setting and Terrain Geomorphology in World Cup Alpine Skiing using Global Navigation Satellite Systems: Injury Risk, Performance and Methodological Aspects. Norwegian School of Sport Sciences Oslo, Dissertation, ISBN Nr. 978-82-502-0500-0.

Meyer, F. (2012). *Biomechanical analysis of alpine skiers performing giant slalom turns*. Faculté des sciences sociales et politiques de l'Université de Lausanne.

Nachbauer, W., Kaps, P., Hasler, M., & Mössner, M. (2016). Friction Between Ski and Snow. *The Engineering Approach to Winter Sports*, 17-32. doi:10.1007/978-1-4939-3020-3_2

Reid, R. C. (2010). *A kinematic and kinetic study of alpine skiing technique in slalom*. Norwegian School Of Sport Science, Oslo. ISBN Nr. 978-82-502-0440-9

Spring, E., Savolainen, S., Erkkilä, J., Hämäläinen, T., & Pihkala, P. (1988). Drag Area of a Cross-Country Skier. *International Journal of Sport Biomechanics, 4*(2), 103-113. doi:10.1123/ijsb.4.2.103

Thompson, B. E., Friess, W. A., & Ii, K. N. (2001). Aerodynamics of speed skiers. *Sports Engineering, 4*(2), 103-112. doi:10.1046/j.1460-2687.2001.00072.x

Biomechanics and kinematic analysis

Watanabe, K., & Ohtsuki, T. (1977). Postural Changes and Aerodynamic Forces in Alpine Skiing. *Ergonomics, 20*(2), 121-131. doi:10.1080/00140137708931611

Biomechanics and kinematic analysis

Title

Kinematic and Kinetic Evaluation of Musculoskeletal Simulations of Squats using experimental data

Authors/Affiliation

Plüss Michael[1], Schellenberg Florian[1], Taylor William R. and Lorenzetti Silvio[1]
[1]Institute for Biomechanics, ETH Zürich, Switzerland

Abstract

Introduction

Further knowledge of the internal loading conditions in the knee could lead to improved design of strength training protocols for injury prevention, rehabilitation and performance enhancement. Musculoskeletal simulation not only provides a promising potential to investigate the forces generated at the knee joint, but also features a solid validation opportunity in terms of measured joint contact force by instrumented total knee arthroplasty. But the possibility and resources to perform joint contact force measurements are still quite limited and the access to anatomical data for subject specific modeling remains also very challenging. To increase the knowledge of internal knee loading during activities with higher joint contact force and range of motion, movements performed during sports or strength training need to be investigated to understand the differences compared to tasks investigated more frequently like gait. Furthermore, activities such as strength training exercising are applicable for musculoskeletal simulation, due to the controlled and slow execution of relatively simple movements. Limited success of matching measured forces of high knee flexion movements with musculoskeletal simulations highlights the problem of model validation and increasing influence of soft tissue artifacts on the skin marker kinematics. Validation based on the measured joint contact force represents the final quality control of a model, where the calculated forces of the muscles and ligaments based on the ground reaction forces must combine to correspond with those measured in the implant. Subject specific modeling represents an advantageous approach for model validation and initial understanding of the investiagted movement. But in order to evaluate the influence of exercise execution on the internal loading conditions during strength training, measurements with more conventional methods and simulations with generic models have to be performed to understand the loading conditions for a broader population than total knee arthroplasty patients.

 Therefor the first aim was to evaluate the differences of the simulated kinematics based on skin markers with the outcome of video-fluoroscopy in order to quantify the inaccuracy of the real bone. The second aim was to evaluate the accuracy of the knee kinetics namely the simulated joint contact force by using an individualized reference model and an instrumented knee prosthesis as gold standard.

Methods

For five valid squat executions performed by 6 subjects (5M, 1F, aged 68±5 years, mass 88±12 kg, height 173±4 cm) with Innex knee implant (Zimmer, Switzerland; type FIXUC), the 3D segment motion was measured using video fluoroscopy and reflective markers, the latter served also as simulation input. All the musculo-skeletal simulations were performed in Opensim (Delp et al., 2007). To achieve a feasible comparison of the kinematic parameters for all the methods, the knee axes definitions of the skin markers, as the conventional and more accessible method, were used as the reference. Which means all three measurement methods and parameter definitions for the analysis were consistently projected onto the same knee axes definition. For the center of rotation definition, the geometric center axis was chosen to allow the parameter description for all measurement approaches including the skin marker analysis. The mean joint angles for all trials per subject as well as for all subjects were calculated. For the assessment of the center of rotation, the spatial difference of the implant and Opensim method were compared to the skin markers in the anatomical directions of the reference axis definitions. Additionally, the root mean square error for each subject and mean over all subjects were calculated between the skin marker analysis and the implant kinematic results

In the kinetic evaluation, the six-component load measurements of 3 contact forces and moments on the tibia component were recorded with a 9-channel telemetry transmitter at a frequency of 90-100 Hz. Additionally, two forces plates (type 9281B and 9287B Kistler, Switzerland) were used to record the

Biomechanics and kinematic analysis

ground reaction force at a frequency of 2kHz. The simulation was performed with the reference "Gait2392" model (Anderson & Pandy, 1999, 2001; Delp et al., 1990; Yamaguchi & Zajac, 1989) including an implementation of virtual markers in the joint centers to allow scaling based on the functional joint center determination of the skin marker kinematics. The maximal and minimal values and the normalized difference between the measured and simulated joint contact forces were used for comparison.

Results

The spatial differences in the medial/lateral and anterior/posterior direction of the center of rotation for the implant and simulation compared to the skin marker method mostly showed an increase towards higher knee flexion angles. For the anterior/posterior translation comparison of the implant and simulation a linear curved correlation was exposed with a diminishing behavior towards the maximum values. The inconsistent characteristics of the differences between the analyzed methods for the ab-/adduction and internal/external rotation angles demonstrated the limited interpretation possibility in the corresponding directions. The underestimation of the knee flexion was clearly visible in the root mean square error assessment as measured using video fluoroscopy and skin marker analysis showed an almost linearly increasing root mean square with increasing knee flexion angles. The concentric part of the squatting movement showed a consistently higher root mean square error compared to the eccentric part of the exercise, but the difference between the two movement cycles was inconsistent and differed for every subject.

Maximum joint contact force in the range of 2.0 to 3.3 times bodyweight were measured by the instrumented implant during the squat execution. In comparison, the simulated maximum joint contact forces were overestimated by approximately 100%, where as in lower flexion angles the simulated forces where lower compared to the measured ones.

Discussion/Conclusion

The rather small differences between the skin marker analysis and Opensim with respect to the movement angles represents a suitable scaling of the model and weighting of the inverse kinematic input parameters. As stated in previous investigations of the soft tissue artifacts, the internal/external rotation and ab-/adduction of the knee may be substantially more affected than the flexion/extension movement (Leardini, Chiari, Della Croce, & Cappozzo, 2005; Reinschmidt, Van den Bogert, Nigg, Lundberg, & Murphy, 1997). In the work of Reinschmidt et al. (1997) it was stated, that the soft tissue artifacts measured by the shank markers mainly induced errors in the sagittal plane, whereas the other knee rotations inaccuracies were caused by the ones located on the thigh. The linearly increasing root mean square error allowed to state an angle dependent correction factor for the skin marker analysis in the sagittal plane. A clear underestimation of the flexion angles has also been reported for the sit-to-stand task with smaller range of motion (Kuo et al., 2011). A simple correction factor provides potential improvement to the marker motion analysis and could be used to improve the input kinematics for musculoskeletal simulation of joint force.

Using the conventional motion capture methods as the input for the simulation with a generic reference model lead to an overestimation, especially for knee flexion angle above 50 degrees, where it reached a factor of up to 3. Similar to the kinematics was also for the joint contact force a linear increase of the normalized difference observable. For the squatting movement only Stylianou, Guess, and Kia (2013) reported a mean absolute deviation of 279N for the vertical joint contact force using a subject specific multibody muscle driven model, which clearly differs in the input data compared to this work. The application of this Opensim model for lower flexion angles was more validated and the authors stated, that for higher flexion angles inaccuracies may be present. Unfortunately for the interests in rehabilitation and sports the highest loading condition in the knee were shown to occur during the high flexions, which also represents the range, where the model as well as the bone kinematics are described with the least accuracy (Lorenzetti et al., 2012). Clearly this work has also its limitations as for example the small number of subjects. But also the comparison of the generic Opensim model, which intends to represent a healthy knee, and an implant design, that did not allow a preservation of the cruciate ligaments, may slightly impact the results.

The previous results clearly show that not only the model validation for high knee flexion movements has to improved but also the input of the bone kinematics to run the musculoskeletal simulations have to be corrected from the influence of the soft tissue artifacts to successfully predict the joint contact

force. Because the misestimated movement angles in the ab-/adduction and rotational direction can cause an extreme impact on the musculoskeletal simulation especially when simulating muscle forces and activities to calculate the joint contact force. Therefore, further investigations should focus on the behavior of the soft tissue artifacts and its impact on the knee ab-/adduction and rotations. And the knowledge of successfully simulated subject specific models should be used to adapt the general models for high knee flexion movements.

References

Anderson, F. C., & Pandy, M. G. (1999). A dynamic optimization solution for vertical jumping in three dimensions. Comput Methods Biomech Biomed Engin, 2(3), 201-231.

Anderson, F. C., & Pandy, M. G. (2001). Dynamic optimization of human walking. J Biomech Eng, 123(5), 381-390.

Delp, S. L., Anderson, F. C., Arnold, A. S., Loan, P., Habib, A., John, C. T., . . . Thelen, D. G. (2007). OpenSim: open-source software to create and analyze dynamic simulations of movement. Biomedical Engineering, IEEE Transactions on, 54(11), 1940-1950.

Delp, S. L., Loan, J. P., Hoy, M. G., Zajac, F. E., Topp, E. L., & Rosen, J. M. (1990). An interactive graphics-based model of the lower extremity to study orthopaedic surgical procedures. IEEE Transactions on Biomedical engineering, 37(8), 757-767.

Kuo, M.-Y., Tsai, T.-Y., Lin, C.-C., Lu, T.-W., Hsu, H.-C., & Shen, W.-C. (2011). Influence of soft tissue artifacts on the calculated kinematics and kinetics of total knee replacements during sit-to-stand. Gait Posture, 33(3), 379-384.

Leardini, A., Chiari, L., Della Croce, U., & Cappozzo, A. (2005). Human movement analysis using stereophotogrammetry: Part 3. Soft tissue artifact assessment and compensation. Gait Posture, 21(2), 212-225.

Lorenzetti, S., Gülay, T., Stoop, M., List, R., Gerber, H., Schellenberg, F., & Stüssi, E. (2012). Comparison of the angles and corresponding moments in the knee and hip during restricted and unrestricted squats. The Journal of Strength & Conditioning Research, 26(10), 2829-2836.

Reinschmidt, C., Van den Bogert, A. J., Nigg, B., Lundberg, A., & Murphy, N. (1997). Effect of skin movement on the analysis of skeletal knee joint motion during running. J Biomech, 30(7), 729-732.

Stylianou, A. P., Guess, T. M., & Kia, M. (2013). Multibody muscle driven model of an instrumented prosthetic knee during squat and toe rise motions. J Biomech Eng, 135(4), 041008. doi:10.1115/1.4023982

Yamaguchi, G. T., & Zajac, F. E. (1989). A planar model of the knee joint to characterize the knee extensor mechanism. J Biomech, 22(1), 1-10.

SGS/4S Young Investigator Award I Final Round

Title

Is physical activity a modifier of the association between air pollution and arterial stiffness in older adults: the SAPALDIA cohort study

Authors/Affiliation

Simon Endes[1], Emmanuel Schaffner[2,3], Seraina Caviezel[2,3], Julia Dratva[2,3], Daiana Stolz[4], Christian Schindler[2,3], Nino Künzli[2,3], Arno Schmidt-Trucksäss[1] and Nicole Probst-Hensch[2,3]

[1]Department of Sport, Exercise and Health, Div. Sports and Exercise Medicine, University of Basel, Switzerland
[2]Swiss Tropical and Public Health Institute, Basel, Switzerland
[3]University of Basel, Basel, Switzerland
[4]Clinic of Pneumology and Respiratory Cell Research, University Hospital, Basel, Switzerland

Abstract

Introduction

Habitual physical activity (PA) and low air pollution exposure are both recommended by global cardiovascular disease prevention guidelines (Piepoli u. a., 2016). Arterial stiffness parameters are considered to be important, independent determinants of improved cardiovascular risk stratification (Laurent u. a., 2006). Easily applicable and non-invasive arterial stiffness measures are now available (Laurent u. a., 2006), and we have proven the high reproducibility of a blood-cuff based arterial stiffness method in the SAPALDIA cohort (Endes, Caviezel, u. a., 2015). We have previously shown that higher levels especially of vigorous PA were cross-sectionally (Endes, Schaffner, u. a., 2015) and in the long-term over a period of almost one decade (Endes u. a., 2016) associated with lower arterial stiffness reflecting lower cardiovascular risk in the SAPALDIA cohort representative for the general Swiss population of older adults. However, the joint association of physical inactivity as well as of air pollution with systemic low grade inflammation, oxidative stress and with related endothelial damage points to the relevance of studying the joint contribution of both risk factors to atherosclerotic processes (Giles & Koehle, 2013; Giorgini u. a., 2015). Furthermore, inhalation of air pollutants is increased during PA (Zuurbier, Hoek, Hazel, & Brunekreef, 2009). Yet, to date the potential interaction of PA and air pollution on cardiovascular health in terms of arterial stiffness has not been studied in detail and not at all in a comparably well characterized cohort like SAPALDIA. Therefore, we can present data of a highly important public health project that provides epidemiologic data on a very hot topic of non-communicable disease prevention on a global scale.

Methods

The data for this study were derived from the second follow-up of the multi-centre cohort study SAPALDIA in eight distinct areas representative of the environmental diversity of Switzerland. A SAPALDIA focus area is the investigation of cardio-respiratory and metabolic effects of air pollution in its ageing cohort. The SAPALDIA follow-up in 2010/11 expanded its focus on chronic disease risks and phenotypes. In the current analysis, complete data of 2823 SAPALDIA participants aged 50-80 years characterized for arterial stiffness, physical activity and residential air pollution exposure were included.

Arterial stiffness was measured non-invasively as the brachial-ankle pulse wave velocity (baPWV [m/s]) with an oscillometric device (Fukuda Denshi, Japan). Common blood pressure cuffs were placed above each ankle and at each upper arm. ECG leads were attached at each wrist and a phonocardiogram on the sternal border in the second intercostal space to assess baPWV by a foot-to-foot method from the upper arm to the ankle as described previously (Endes, Caviezel, u. a., 2015).

Physical activity data were derived from the SAPALDIA main questionnaire to classify the subjects' physical activity level. Four questions were asked concerning the frequency and duration of physical activities per week. Physical activities with episodes of getting a bit out of breath were categorized as moderate intensity and physical activities linked with getting out of breath and sweating as vigorous intensity, respectively. On this basis we categorized the SAPALDIA participants as either inactive (0

38

minutes of moderate-to-vigorous physical activity peer week) or at least a bit active (≥ 1 minute moderate-to-vigorous physical activity).

Air pollution exposure was estimated by the annual average individual home outdoor PM_{10} and $PM_{2.5}$ (particulate matter <10 μm and <2.5 μm in diameter, respectively), NO_2 (nitrogen dioxide) exposure estimated for the year preceding the survey. Exposure estimates for ultrafine particles calculated as particle number concentration (PNC) and lung deposited surface area (LDSA) were available for a subsample (N=1353).

We used mixed logistic regression models to regress increased arterial stiffness (baPWV ≥ 14.4 m/s) on air pollution exposure and physical activity while adjusting for relevant confounders. The crude models included physical activity and one home outdoor air pollutant at a time (PM_{10}, $PM_{2.5}$, NO_2, PNC or LDSA) as main predictors with a random study area effect. The minimal models were additionally adjusted for age and sex. The main models included further adjustment for education, socioeconomic position, packyears of smoking, body mass index (BMI), heart rate and mean arterial pressure. The interaction models included an interaction term between physical activity and one home outdoor air pollutant at a time in addition to the main model. We performed sensitivity analyses using the fully-adjusted single-pollutant model stratified by doctor diagnosed CVD status, BMI (cut-offs 25 and 30 kg/m2), age (cut-off 65 years) and education level (comparing the highest with the lower two levels). Furthermore we checked the regressions estimates using different physical activity categorizations and also by using a fixed area effect. The results were also compared to models including a continuous baPWV outcome. Chi2-tests were used to compare regression estimates of stratified analyses. All statistical analyses were performed using the statistical software STATA (StataCorp LP, USA) with $p < 0.05$ defining statistical significance.

Results

Mixed logistic regression models for assessing the independent adjusted effects of specific air pollution parameters and physical activity showed an inverse association between physical activity and increased arterial stiffness, whereas no main effect was observed for any of the air pollution parameters tested.

When assessing our a priori hypothesis of an interaction between air pollution and physical activity, we observed that the probability of having increased baPWV significantly increased with higher PM_{10}, $PM_{2.5}$, NO_2, PNC and LDSA exposure in inactive participants, whereas there was no evidence of an association in active participants (exemplarily for PM_{10} and $PM_{2.5}$ in Fig. 1). The interactions were statistically significant for PM_{10}, $PM_{2.5}$ and NO_2 ($p_{interaction}$=0.06, 0.09 and 0.04), but not in the models for PNC or LDSA, where the sample size was smaller ($p_{interaction}$= 0.32 and 0.35).

We conducted several sensitivity analyses showing that the results were robust. We assessed a three categorical physical activity variable (0, 1-150, >150 min/week of moderate-to-vigorous physical activity) showing comparable results. Furthermore, the effect estimates were not materially different in models including a fixed area effect. The effect estimates presented did not differ by educational status, between persons above or below 65 years and persons with or without overweight/adiposity (cut-offs 25 and 30 kg/m2) or CVD. Furthermore, using baPWV as a continuous outcome supported the results of this study (data of sensitivity analyses not shown).

Discussion/Conclusion

To the best of our knowledge this is the first population based cohort providing epidemiological evidence concerning interactions between physical activity and several air pollution matrices in view of arterial stiffness. Arterials stiffness is an important early predictor of cardiovascular diseases. The probability of having arterial stiffness above normal values increased with higher PM_{10}, $PM_{2.5}$, NO_2, PNC and LDSA exposure in participants without weekly moderate-to-vigorous physical activity.

Our results extend current reviews on air pollution, physical activity and health, which summarize that the beneficial health and in particular vascular effects of physical activity outweigh the risks linked with increased air pollution inhalation (Giles & Koehle, 2013; Giorgini u. a., 2015). In our study we observed that physical activity was associated with decreased arterial stiffness independent of air pollution exposure. A recent Danish cohort report pointed out that traffic related air pollution did not modify the beneficial effects of long-term physical activity on mortality (Andersen u. a., 2015). Mortality was lower in participants with regular leisure-time physical activity independent of the level of NO2 in a cohort of 52'061 adults 50-65 years of age over a mean follow-up of 13 years. Our results instead point to an interaction between air pollution and physical inactivity and suggest that physical activity may

39

protect against the adverse effects of air pollution. Persons without any minutes per week of moderate-to-vigorous physical activity seem to be susceptible to the unhealthy cardiovascular pathway enhanced by air pollution. These results suggest that inactive persons may lack the presumable protective effects of physical activity on vascular function in polluted areas.

This study benefits from the detailed characterization of the SAPALDIA cohort for over 25 years concerning the extensive air pollution and covariates assessment. Furthermore, the SAPALDIA cohort is representative for an ageing cohort of adults, which is prospectively evaluated and screened. The greatest novelty of this study is the analysis of several air pollution parameters, which were included in addition to PM_{10}, $PM_{2.5}$ and NO_2 also UFP and using LDSA as a novel metric of the toxicological health effects of air pollution on the cardio-pulmonary system and physical activity. This is the first epidemiological study using baPWV as a marker of systemic arterial stiffness and cardiovascular risk related to the air pollution – physical activity interaction. Arterial stiffness represents vascular function and vascular ageing and may be more sensitive to physical activity related health benefits than e.g. carotid intima-media thickness. This study is limited by its cross-sectional design, which does not allow for the interpretation of causality. Furthermore, there is a high correlation between each of the studied air pollution exposures limiting the assessment of independent pollutant associations. baPWV is not the gold-standard for measuring arterial stiffness, however, has shown good associations with cardiovascular outcomes (Vlachopoulos, Aznaouridis, Terentes-Printzios, Ioakeimidis, & Stefanadis, 2012). We used a dichotomous baPWV outcome, which may imply losing power concerning dose-response interpretation. However, using a cut-off for increased arterial stiffness reflecting higher cardiovascular risk in this cohort sets the results into a clinically relevant perspective.

In conclusion, our study provides novel evidence that physical activity may protect against the adverse vascular effects of air pollution in low pollution settings. Additional research in large prospective cohorts is needed to assess whether the observed effect modification translates to high pollution settings in mega-cities of middle and low income countries.
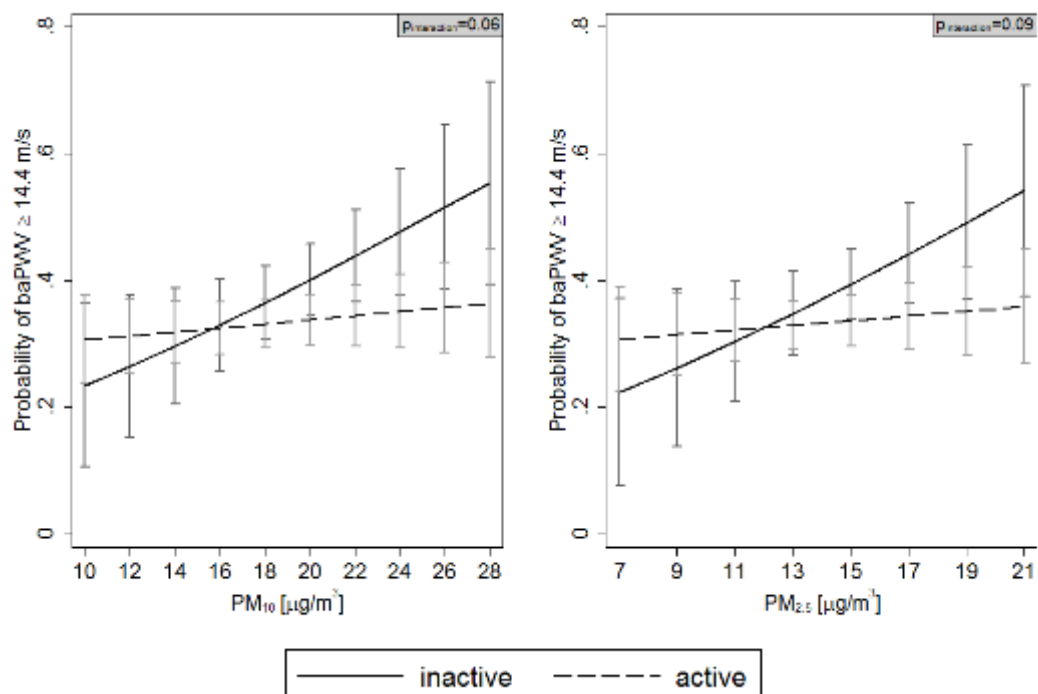

Figure 1. Association between the probability of increased brachial-ankle pulse wave velocity (baPWV) and particulate matter (PM10, PM2.5) among physically active and inactive subjects. All models are adjusted by age, sex, education, socioeconomic position, packyears of smoking, body mass index, heart rate and mean arterial pressure.

References

Andersen, Z. J., de Nazelle, A., Mendez, M. A., Garcia-Aymerich, J., Hertel, O., Tjønneland, A., … Nieuwenhuijsen, M. J. (2015). A Study of the Combined Effects of Physical Activity and Air Pollution on Mortality in Elderly Urban Residents: The Danish Diet, Cancer, and Health Cohort. *Environmental Health Perspectives*. https://doi.org/10.1289/ehp.1408698

Endes, S., Caviezel, S., Dratva, J., Schaffner, E., Schindler, C., Rothe, T., … Schmidt-Trucksäss, A. (2015). Reproducibility of oscillometrically measured arterial stiffness indices: Results of the SAPALDIA 3 cohort study. *Scandinavian Journal of Clinical & Laboratory Investigation*, *75*(2), 170–176. https://doi.org/10.3109/00365513.2014.993692

Endes, S., Schaffner, E., Caviezel, S., Dratva, J., Autenrieth, C. S., Wanner, M., … Schmidt-Trucksäss, A. (2015). Physical activity is associated with lower arterial stiffness in older adults: results of the SAPALDIA 3 Cohort Study. *European Journal of Epidemiology*, *31*(3), 275–285. https://doi.org/10.1007/s10654-015-0076-8

Endes, S., Schaffner, E., Caviezel, S., Dratva, J., Autenrieth, C. S., Wanner, M., … Schmidt-Trucksäss, A. (2016). Long-term physical activity is associated with reduced arterial stiffness in older adults: longitudinal results of the SAPALDIA cohort study. *Age and Ageing*, *45*(1), 110–115. https://doi.org/10.1093/ageing/afv172

Giles, L. V., & Koehle, M. S. (2013). The Health Effects of Exercising in Air Pollution. *Sports Medicine*, *44*(2), 223–249. https://doi.org/10.1007/s40279-013-0108-z

Giorgini, P., Rubenfire, M., Bard, R. L., Jackson, E. A., Ferri, C., & Brook, R. D. (2015). Air Pollution and Exercise: A REVIEW OF THE CARDIOVASCULAR IMPLICATIONS FOR HEALTH CARE PROFESSIONALS. *Journal of Cardiopulmonary Rehabilitation and Prevention*, 1. https://doi.org/10.1097/HCR.0000000000000139

Laurent, S., Cockcroft, J., Van Bortel, L., Boutouyrie, P., Giannattasio, C., Hayoz, D., … European Network for Non-invasive Investigation of Large Arteries. (2006). Expert consensus document on arterial stiffness: methodological issues and clinical applications. *European Heart Journal*, *27*(21), 2588–2605. https://doi.org/10.1093/eurheartj/ehl254

Piepoli, M. F., Hoes, A. W., Agewall, S., Albus, C., Brotons, C., Catapano, A. L., … Verschuren, W. M. M. (2016). 2016 European Guidelines on cardiovascular disease prevention in clinical practice. *European Heart Journal*, ehw106. https://doi.org/10.1093/eurheartj/ehw106

Vlachopoulos, C., Aznaouridis, K., Terentes-Printzios, D., Ioakeimidis, N., & Stefanadis, C. (2012). Prediction of Cardiovascular Events and All-Cause Mortality With Brachial-Ankle Elasticity Index: A Systematic Review and Meta-Analysis. *Hypertension*, *60*(2), 556–562. https://doi.org/10.1161/HYPERTENSIONAHA.112.194779

Zuurbier, M., Hoek, G., Hazel, P. van den, & Brunekreef, B. (2009). Minute ventilation of cyclists, car and bus passengers: an experimental study. *Environmental Health*, *8*(1), 48. https://doi.org/10.1186/1476-069X-8-48

41

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Title

Types of professionalisation in Swiss national sport federations

Authors/Affiliation

Grazia Lang[1], Torsten Schlesinger[2], Markus Lamprecht[3], Kaisa Ruoranen[1], Christoffer Klenk[1], Emmanuel Bayle[4], Josephine Clausen[4], David Giauque[5], Siegfried Nagel[1]

[1]Institute of Sport Science, University of Bern, Bern, Switzerland; [2]Institute of Human Movement Science, Chemnitz University of Technology, Chemnitz, Germany; [3]Swiss Observatory for Sport and Physical Activity, Zürich, Switzerland; [4]Institute of Sport Science, University of Lausanne, Lausanne, Switzerland; [5]Institute of Political, Historical and International Studies, University of Lausanne, Lausanne, Switzerland

Abstract

Introduction

National sport federations (NSFs) face many challenges: from increasing competition and growing organisational requirements of top-level sports to the importance of service orientation and quality management (Nagel, Schlesinger, Bayle, & Giauque, 2015). These challenges produce a "transition from an amateur, volunteer-driven pastime to a more business-like sector" (Shilbury & Ferkins, 2011, p. 108). A process of professionalisation appears to be the appropriate strategy to deal with these challenges, and can result in the adoption of contemporary management structures, formalised processes, implementation of management instruments and employment of paid staff (cf. Maier, Meyer, & Steinbereithner, 2016). However, increased professionalisation may not meet the needs of all organisations. In fact, the NSFs are characterised by distinctive organisational structures, goals and culture (Slack & Parent, 2006) and may follow various strategies in the professionalisation process. As a consequence, different types of professionalisation may arise. In a two step process, the study asked two questions: *Which types of professionalisation exist in Swiss national sport federations?* and *How can these types be further described using organisational characteristics?* The research into the various types of professionalisation in Swiss NSFs was undertaken using a conceptual framework of forms of professionalisation in sport federations by Ruoranen et al. (2016). To characterise and validate these types of professionalisation, further organisational characteristics proposed in the multi-level framework by Nagel et al. (2015) were used.

Existing research identifies types related to levels of professionalisation (e.g. Kikulis, Slack, & Hinings, 1992; Nichols & James, 2008), however, the levels of professionalisation do not adequately represent the complexity of organisational designs and fail to identify the possible variety of organisational design types. In addition, these studies do not apply systematic operationalisation or standardised survey instruments. Instead, the types are generated using theoretical approaches or qualitative investigations. This study's standardised survey method enables a quantitative comparison of all Swiss NSFs and it is replicable in, or at least adaptive to, other institutional settings (e.g. other countries, other kinds of sport organisations). The results provide a deeper understanding of the diversity of the NSFs' organisational designs, and the reasons for different types of professionalisation. For Swiss Olympic – the umbrella federation of Swiss NSFs – the results enable the more efficient consultation with representatives of Swiss NSFs in the professionalisation process of the federation.

Methods

Every six years, Swiss Olympic in cooperation with "Lamprecht & Stamm Sozialforschung und Beratung AG" conducts an online survey of Swiss NSFs. Our study was able to integrate specific items into this questionnaire in order to gather data on the NSFs' professionalisation processes. All member federations of Swiss Olympic (n=85) are obliged to participate in the survey in order to be funded, so the response rate was 100%. Ten member federations that do not represent any particular sport (e.g. Swiss paraplegic foundation), and six NSFs that provided incomplete data were excluded from the data analysis. Thus, the total sample was 69 NSFs.

As standardised questionnaires on forms of professionalisation do not currently exist, we conducted an exploratory factor analysis using principal components analysis and varimax rotation to operationalise the dimensions of (1) strategies and activities and (2) structures and processes. To

measure the professionalisation of strategies and activities, cluster variables of (1.1) growth orientation and (1.2) quality and service orientation were identified, and explain 56,5% of the variance. For the structures and processes of the NSFs, the factors (2.1) formalisation of strategy, (2.2) formalisation of marketing and communication and (2.3) formalisation of human resource management were determined. These explain 57,3% of the variance. The factors measuring the professionalisation of (3) people and positions were generated according to insights gained from theory and literature analysis. At this point three factors emerged: (3.1) the proportion of voluntary staff in relation to paid staff in the federation, (3.2) the total number of paid staff in the management board, executive office and committees ("paid executives"), and (3.3) the proportion of paid staff in the sport sector (e.g. paid coaches, athletes) in relation to paid executives. Implementing these eight cluster variables, NSFs with similar forms of professionalisation were grouped using a hierarchical cluster analysis based on Ward's algorithm and squared Euclidean distances. The Scree-Plot (elbow-criterion) did not indicate a particular cluster solution. A closer examination of the data and the differences between the clusters resulted in a four cluster solution.

To describe the clusters in more detail, further organisational characteristics, such as size, financial resources, Olympic vs. non-Olympic sport, as well as performance (classified by Swiss Olympic), were analysed. The multi-level framework by Nagel et al. (2015) suggests that these characteristics cause and result from professionalisation. This second step analysis is important to the quality of the cluster analysis. As the types are expected to differ in their organisational characteristics, these analyses are considered as indicators of external validity of the cluster solution.

Results

Four types of professionalisation were identified:

Cluster 1: Formalised federations managed by paid staff (n=14; 20,3%): These NSFs show a conspicuously high degree of formalisation in each factor measured, as well as strong business-like characteristics of employment. The latter is suggested due to a relatively low proportion of voluntary staff in relation to paid staff in these federations and a high number of paid executives compared to the other types.

Cluster 2: Federations managed by volunteers and a few paid executives (n=13; 18,8%): These federations show rather high formalisation scores, although they are managed on an average of 90% by volunteers. The fact that there are still three to four paid executives in these federations' management makes a significant difference to federations managed exclusively by volunteers.

Cluster 3: Strategic oriented federations with paid staff in the sport sector (n=17; 24,6%): They are mainly characterised by the high proportion of paid staff in the sport sector (62%). According to this result, there is more paid staff employed in these federations' sport sector than in their management. Additionally, this cluster shows very high values in the factors measuring strategic orientation, that is to say a strong orientation towards growth, quality and service.

Cluster 4: Moderately formalised federations managed by volunteers (n=25; 36,2%): These federations are almost exclusively managed by voluntary staff, as they have an average of only one paid employee in the federation. These federations show rather low values of formalisation of structures and processes, particularly regarding strategy and HRM.

When considering further organisational characteristics, the results indicate that the formalised federations managed by paid staff (cluster 1) are the largest, and appear to require a considerable number of paid staff and formalisation to manage their daily business. Accordingly, they have more financial resources to meet these needs. Examples in this cluster are the Swiss football federation or Swiss-Ski. The federations in cluster 2 demonstrate that business-like management with a small executive office and formalised structures and processes is possible, despite scarce financial resources for such middle-sized federations (e.g. Swiss Archery). The federations in cluster 3 are comparatively small federations and most often representing an Olympic sport. Paid staff in the sport sector appears to be required for these NSFs, for example Swiss rowing and Swiss fencing. Their growth, quality and service orientation may also be associated with an Olympic federation's need to continuously develop the sport sector. The moderately formalised federations managed by volunteers (cluster 4) are small federations with scarce financial resources, for example the billiard, street hockey or squash federations. Swiss Olympic rates the performance of cluster 1 the highest, clusters 2 and 4 are classified equally, but at lower performance than clusters 1 and 3.

The validation of the clusters using objective measures was satisfactory, as most organisational characteristics showed considerable differences between the clusters, and values that are consistent with earlier studies.

Discussion/Conclusion

In contrast to existing design types, the four types identified do not refer to levels of professionalisation. The importance of the measured forms of professionalisation differs between the types and appears to be associated with organisational characteristics such as size, financial resources and Olympic vs. non-Olympic sport. We conclude there is no ideal path to professionalisation, but the type of professionalisation should be in accordance with the preconditions and objectives of an organisation. Such an approach would ensure the effective support and consultation with the NSFs.

The structural stability of the cluster solution is fairly low when testing different cluster algorithms and examining the allocation of federations to the clusters. However, the cluster centres remain similar, and another algorithm would not generate a different interpretation of the clusters. A standardised survey is unable to measure certain factors of professionalisation, for example, decision-making processes. It would be fruitful to conduct qualitative, in-depth case studies into each type of professionalisation, in order to gain deeper insights into the characteristics as well as the formative processes of the types. The results of this study are representative for Switzerland, and not applicable to other countries due to differences in the subsidy system and national popularity of a sport.

References

Kikulis, L. M., Slack, T., & Hinings, C. R. (1992). Institutionally specific design archetypes: A framework for understanding change in national sport organizations. *International Review for Sociology of Sport*, *27*, 343–368. doi:10.1177/101269029202700405

Maier, F., Meyer, M., & Steinbereithner, M. (2016). Nonprofit organizations becoming business-like: A systematic review. *Nonprofit and Voluntary Sector Quarterly*, *45*, 64–86. doi:10.1177/0899764014561796

Nagel, S., Schlesinger, T., Bayle, E., & Giauque, D. (2015). Professionalisation of sport federations – a multi-level framework for analysing forms, causes and consequences. *European Sport Management Quarterly*, *15*, 407–433. doi:10.1080/16184742.2015.1062990

Nichols, G., & James, M. (2008). One size does not fit all: Implications of sports club diversity for their effectiveness as a policy tool and for government support. *Managing Leisure*, *13*, 104–114. doi:10.1080/13606710801933461

Ruoranen, K., Klenk, C., Schlesinger, T., Bayle, E., Clausen, J., Giauque, D., & Nagel, S. (2016). Developing a conceptual framework to analyse professionalisation in sport federations. *European Journal for Sport and Society*, *13*, 55–74. doi:10.1080/16138171.2016.1153881

Shilbury, D., & Ferkins, L. (2011). Professionalisation, sport governance and strategic capability. *Managing Leisure*, *16*, 108–127. doi:10.1080/13606719.2011.559090

Slack, T., & Parent, M. (2006). Understanding sport organizations: The application of organization theory (2nd ed.). Champaign, IL: Human Kinetics.

SGS/4S Young Investigator Award I Final Round

Title

A warm-up programme to prevent injuries in children's football: cluster randomised controlled trial

Authors/Affiliation

Roland Rössler[1], Astrid Junge[2,3], Mario Bizzini[2], Evert Verhagen[4], Jiri Chomiak[5], Karen aus der Fünten[6], Tim Meyer[6], Jiri Dvorak[2], Eric Lichtenstein[1], Florian Beaudouin[6], Oliver Faude[1]

[1]Department of Sport, Exercise and Health, University of Basel, Basel, Switzerland

[2]Schulthess Clinic, Zurich, Switzerland

[3]Medical School Hamburg, Hamburg, Germany

[4]Amsterdam Collaboration on Health and Safety in Sports, Department of Public and Occupational Health & Amsterdam Movement Sciences, VU University Medical Center, Amsterdam, Netherlands

[5]Department of Orthopaedics, 1st Faculty of Medicine of Charles University and Hospital Na Bulovce, FIFA – Medical Centre of Excellence, Prague, Czech Republic

[6]Institute of Sports and Preventive Medicine, Saarland University, FIFA – Medical Centre of Excellence, Saarbrücken, Germany

Abstract

Introduction

Worldwide, the highest proportion of football players (58%) is younger than 18 years (FIFA Communications Division, 2007). Playing football can induce considerable health benefits, and thus, football has a great potential to support a healthy lifestyle from a young age onwards (Bangsbo, Junge, Dvorak, & Krustrup, 2014). Football, however, is also a high-intensity and high-impact sport with many situations of direct contact between players, which bear the risk of injury.

Despite the need to prevent injuries in children's football, so far no study has investigated the prevention of football injuries in children under the age of 13 years (Rössler et al., 2014). Based on a topical review (Faude, Rössler, & Junge, 2013) and an epidemiological study on injuries in children's football (Rössler, Junge, Chomiak, Dvorak, & Faude, 2016), an age-specific injury prevention programme ("FIFA 11+ Kids") was developed tailored for young players (7 to 13 years). A pilot study showed slight improvements in motor performance (Rössler, Donath, Bizzini, & Faude, 2016).

The present study evaluated the efficacy of the "FIFA 11+ Kids" programme to reduce the number of injuries in 7- to 13-year-old football players. We hypothesised that the overall injury incidence would be reduced by at least one third in the intervention group compared to a control group (Rössler et al., 2014).

Methods

The study was a two-armed cluster-randomised controlled trial (level of evidence 1) conducted as a multi-centre study in four countries (Switzerland, Germany, the Czech Republic, the Netherlands). The trial was registered in the ClinicalTrials.gov registry (NCT02222025). Clubs who agreed to participate were randomised to an intervention (INT) or a control group (CON), and followed for one season.

We recruited teams from the age categories under-9, under-11, and under-13 participating in regular training and match play in an officially registered football club.

Injury characteristics and football exposure were assessed using guidelines for football injury research (Fuller et al., 2006). An injury was defined as any physical complaint sustained by a child during a scheduled training session or match play resulting in (a) the inability to complete the current match or training session, (b) the absence from subsequent training sessions or matches and/or (c) the injury requiring medical attention.

Continuous surveillance of player-specific football exposure, sustained injuries, and session-based information about "FIFA 11+ Kids" utilisation (INT only) was accomplished using an internet-based injury registration system. If an injury occurred, trained study assistants contacted the coach as well as the player and the parents via telephone and/or e-mail to assess all relevant aspects of the injury based on a standardised injury registration form. In case of injuries which required medical treatment, parents were instructed to obtain the exact diagnosis from the treating physician. In addition, two

investigators who were blinded to group allocation screened all information regarding each injury to enable an objective and independent injury classification.

"FIFA 11+ Kids" is an injury prevention programme specifically tailored for children's football. The structure of the programme refers to the established "FIFA 11+" programme, which has been shown to be efficacious in players older than 13 years (Silvers-Granelli et al., 2015; Soligard et al., 2008). "FIFA 11+ Kids" consists of seven different exercises and can be performed in about 15 to 20 min after familiarisation. Three exercises focus on unilateral, dynamic stability of the lower extremities (hopping, jumping and landing). Further, three exercises emphasise whole body and trunk strength and stability. The last exercise contains rolling tasks to improve falling technique. Coaches received a printed version of the "FIFA 11+ Kids" manual and a short version "for the pitch" where all exercises were illustrated.

Player-specific time-to-injury data were analysed using extended Cox models. These models contained mixed (random and fixed) effects accounting for potential clustering effects on team level. Additionally, these models allowed to analyse multiple injuries of players while accounting for potential correlations on intra-person-level. Compliance was analysed using a tercile split of the INT players according to their monthly "FIFA 11+ Kids" completion-rate (Silvers-Granelli et al., 2015). We compared the three INT-groups (HIGH/MID/LOW utilisation rate) against each other as well as against CON using extended Cox models. We used player-specific compliance data. Therefore, the actual individual exposure to the intervention programme was taken into account.

Results

In total, 292,749 hours of football exposure (7,026 hours (2.4%) completed by girls) of 3,895 players (N = 171 (4.4%) girls) were recorded. The mean age of players was 10.8 (SD 1.4) years. INT and CON players were of similar age, body mass and height.

The overall injury rate in INT was reduced by 48% compared to CON (Hazard Ratio, HR 0.52; 95%-CI 0.32 to 0.86). Severe injuries (HR 0.26; 95%-CI 0.10 to 0.64) and lower extremity injuries (HR 0.45; 95%-CI 0.24 to 0.84) were also reduced. Additional reductions were found regarding match injuries (HR 0.51; 95%-CI 0.27 to 0.94), training injuries (HR 0.58; 95%-CI 0.38 to 0.89), and collision-related injuries (HR 0.30; 95%-CI 0.09 to 0.98). Mean lay-off time (INT: 14.6d (SD 18.3) and CON: 17.9d (SD 23.1)) and the total number of days lost due to injury (INT: 2,026d and CON: 4,201d) were lower in INT.

Knee, ankle, thigh, and hip/groin injuries were less frequent in INT with HRs ranging between 0.40 and 0.52. Joint/ligament, muscle injuries, traumatic fractures, as well as overuse-related complaints showed HRs between 0.12 and 0.56. Also running/jumping, overuse/growth, and collision-related injuries were lower in INT with HRs between 0.30 and 0.52. However, confidence intervals were large due to the low number of injuries in these injury-subcategories.

Injury risk decreased with increasing utilisation rate of the "FIFA 11+ Kid" programme. The risk of injury was lower in the high compliance group (HIGH versus CON: HR 0.44; 95%-CI 0.28 to 0.69) and the middle compliance group (MID versus CON: HR 0.62; 95%-CI 0.40 to 0.97). The risk of injury in HIGH was half compared to LOW (HR 0.50; 95%-CI 0.29 to 0.84).

The compliance-threshold analysis revealed that the additional benefit of each additional session per month was stable in players who performed the programme up to 3 times per month. Above 3 sessions per month the influence of compliance increases and reaches the highest additional benefit (per additional session) at 5 sessions per month. Thereafter, a higher compliance still further reduces injury rates but the additional benefit of additional monthly sessions decreases again.

Discussion/Conclusion

The age-specific warm-up programme "FIFA 11+ Kids" was designed to prevent injuries in children's football. The main finding was an overall reduction of injuries in the intervention group by 48% compared to the control group. Particularly large protective benefits were found for severe injuries (74%). The number of days lost to injury was considerably reduced in the intervention group. Compliance (i.e. regular and frequent application of the prevention programme) is crucial to profit from a protective effect and/or to increase this effect. To the best of our knowledge this is the first study to investigate the effects of a tailored injury prevention programme for organised sport in children younger than 13 years of age.

The mean injury lay-off time was reduced in INT. Importantly, also the total number of days lost to injury (i.e. absence from sport participation) was considerably lower (less than half). This indicates that

injury prevention could also support children achieving higher physical activity levels with all its positive health effects as it allows for more consistent training participation (Janssen & Leblanc, 2010).

The compliance analysis showed a clear dose-response-relationship between the frequency of doing "FIFA 11+ Kids" and the injury rate. Based on these data we can recommend to regularly perform the programme at least once every week to profit from a protective effect. However, it should be aimed at two sessions per week (or more if indicated) to maximise the benefits of the intervention programme. Injury risk was reduced by 56% in the HIGH compliance group. Interestingly, MID also showed reductions in injury risk compared to CON, although utilisation rate was just about one session per week.

"FIFA 11+ Kids" is a valuable complement to the existing "FIFA 11+". It extends the age range of football injury prevention down to the age of 7 years utilising tailored, age-specific exercises.

References

Bangsbo, J., Junge, A., Dvorak, J., & Krustrup, P. (2014). Executive summary: Football for health - prevention and treatment of non-communicable diseases across the lifespan through football. *Scand J Med Sci Sports, 24 Suppl 1*, 147-150. doi: 10.1111/sms.12271

Faude, O., Rössler, R., & Junge, A. (2013). Football injuries in children and adolescent players: are there clues for prevention? *Sports Med, 43*(9), 819-837. doi: 10.1007/s40279-013-0061-x

FIFA Communications Division. (2007). FIFA Big Count 2006: 270 million people active in football *Information Services*. Zurich.

Fuller, C. W., Ekstrand, J., Junge, A., Andersen, T. E., Bahr, R., Dvorak, J., . . . Meeuwisse, W. H. (2006). Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Br J Sports Med, 40*(3), 193-201. doi: 10.1136/bjsm.2005.025270

Janssen, I., & Leblanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act, 7*, 40. doi: 10.1186/1479-5868-7-40

Rössler, R., Donath, L., Bizzini, M., & Faude, O. (2016). A new injury prevention programme for children's football - FIFA 11+ Kids - can improve motor performance: a cluster-randomised controlled trial. *J Sports Sci, 34*(6), 549-556. doi: 10.1080/02640414.2015.1099715

Rössler, R., Donath, L., Verhagen, E., Junge, A., Schweizer, T., & Faude, O. (2014). Exercise-based injury prevention in child and adolescent sport: a systematic review and meta-analysis. *Sports Med, 44*(12), 1733-1748. doi: 10.1007/s40279-014-0234-2

Rössler, R., Junge, A., Chomiak, J., Dvorak, J., & Faude, O. (2016). Soccer Injuries in Players Aged 7 to 12 Years: A Descriptive Epidemiological Study Over 2 Seasons. *Am J Sports Med, 44*(2), 309-317. doi: 10.1177/0363546515614816

Silvers-Granelli, H., Mandelbaum, B., Adeniji, O., Insler, S., Bizzini, M., Pohlig, R., . . . Dvorak, J. (2015). Efficacy of the FIFA 11+ Injury Prevention Program in the Collegiate Male Soccer Player. *Am J Sports Med, 43*(11), 2628-2637. doi: 10.1177/0363546515602009

Soligard, T., Myklebust, G., Steffen, K., Holme, I., Silvers, H., Bizzini, M., . . . Andersen, T. E. (2008). Comprehensive warm-up programme to prevent injuries in young female footballers: cluster randomised controlled trial. *Bmj, 337*, a2469.

SGS/4S Young Investigator Award I Final Round

Title

Effect of high intensity interval and endurance respiratory muscle training on respiratory muscle performance measured with a novel incremental respiratory muscle test

Authors/Affiliation

Corina E. Schaer[1], Donat Roduner[1], Fernando G. Beltrami[1], Thomas U. Wüthrich[1], Christina M. Spengler[1,2]

[1]*Exercise Physiology Lab, Institute of Human Movement Sciences and Sport, ETH Zurich, Switzerland,*
[2]*Zurich Center for Integrative Human Physiology (ZIHP), University of Zurich, Switzerland*

Abstract

Introduction

Respiratory muscle training (RMT) has been shown to improve physical performance in both healthy individuals (Illi *et al.*, 2012) and different groups of patients (Smart *et al.*, 2013). Muscle contractions in existing RMT regimens are either performed at high force and low velocity (i.e. strength training) or at low force and high velocity (i.e. endurance training). Analogous to whole-body exercise training, specific muscular adaptations can be expected depending on the type of RMT performed, i.e. inspiratory muscle strength training was shown to improve maximal respiratory muscle force and respiratory muscle endurance training (RMET) to improve endurance-related parameters (Verges *et al.*, 2009). Nonetheless, respiratory muscle adaptions with RMT are not yet fully understood because of its complex mechanics and the difficulty to access the many muscles involved in in- and expiration. The responses to stimuli of different RMT regimens of respiratory muscles are therefore difficult to predict. Although it has been demonstrated that sprint-like efforts of respiratory muscles (RMSIT) can induce similar levels of respiratory muscle fatigue as longer-duration RMET (Wüthrich *et al.* 2015), the extent to which RMSIT improves respiratory muscle performance compared to RMET is still unknown. In addition to training specificity, a further complication arises when comparing different RMT programs, i.e. despite the different tests available to measure respiratory muscle performance (e.g.. incremental threshold loading or constant load hyperpnoea), none of the protocols has been established so far (Sales et al., 2016). Currently, no respiratory muscle test exists combining in- and expiratory muscle endurance and strength, placing a concomitant load on the entire respiratory system. To this end, we recently designed an innovative incremental respiratory muscle test (IncRMT) combining high in- and expiratory pressures and flows. In short, we developed a custom-made rebreathing device enabling accurate, constant step-wise increases in work of breathing (WOB), achieved by increasing respiratory resistance and ventilation. The purpose of the present study was to assess changes in respiratory muscle performance after 4 weeks of RMET and RMSIT with the IncRMT and to assess physiological changes associated with potential muscular adaptations.

Methods

Thirtythree healthy, moderately trained males and females (age: 26±5years, $\dot{V}O_{2peak}$: 47±12ml·min^{-1}·kg^{-1}) were randomized and balanced into three groups according to their sex, age and aerobic capacity (m/f; RMET 6/6; RMSIT 5/6); SHAM 5/6). Participants performed lung function and respiratory muscle strength measurements as well as an IncRMT until exhaustion before and after four weeks of respiratory muscle training. During the IncRMT muscle activity was assessed via surface electromyography (EMG), and oxygen extraction capacity via near-infrared spectroscopy (NIRS) of abdominal (ABDO), intercostal (INTER), sternocleidomastoid (STERNO) muscles. RMET consisted of 30-min sessions of normocapnic hyperpnea at 60-85% of maximal voluntary ventilation (MVV) performed 4-5x/week (20 sessions in total); RMSIT involved three weekly sessions (12 sessions in total) of 6x 1min (1 min break) normocapnic hyperpnea at 55-65%MVV with added in- and expiratory resistance; and SHAM consisted of one single inhalationof a SHAM bronchodilating substance followed by 5 vital capacity manoeuvres (4-5x/week; 20 sessions in total). Within-group changes were tested with a paired t-test and changes from pre- to post-training were compared between groups using a one-way ANOVA. EMG and NIRS values were normalized to the first 20% of the IncRMT. Significance was accepted at p<0.05.

Results

Lung function did not change significantly in any group. In RMET, MVV increased significantly (+9.1±7.0L·min^{-1*}) and showed a similar trend in RMSIT (+9.6±15.9L·min^{-1}, p=0.09). Maximal expiratory pressure (MEP) showed a trend towards increase after RMSIT (+11.9±18.4 cmH$_2$O, p=0.07).

48

During both RMSIT and RMET, WOB during training sessions increased significantly with no difference of WOB changes between groups (RMET: +26.2±16.1kJ, RMSIT: +17.4±8.9kJ, p=0.143). Average mouth pressure during RMSIT increased to a greater extent than during RMET (RMSIT: +20.0±15.0cmH$_2$O, RMET: +3.3±1.5cmH$_2$O, p=0.001) while ventilation increased less with RMSIT than with RMET (RMSIT: +14.4±6.1L·min^{-1*}, RMET: +32.1±10.5L·min^{-1*}, p<0.001). Duration of the IncRMT increased significantly in both RMT groups compared to SHAM (RMSIT: +5.6±2.1min, p=0.001; RMET: +3.8±4.2min, p=0.014; SHAM: -0.6±3.7min) and total inspiratory WOB were significantly larger for both RMTs compared to SHAM (RMSIT: +2.02±0.75kJ, p<0.001, RMET: +1.43±1.20kJ, p=0.003, SHAM: -0.22±1.24kJ). Similarly, changes in expiratory WOB differed significantly from SHAM (RMSIT: +2.85±1.45kJ, p<0.001, RMET: +1.5±1.59kJ, p=0.006, SHAM: -0.79±1.88kJ). During the IncRMT, the activity of STERNO during inspiration and INTER during expiration decreased following RMSIT compared with SHAM (STERNO: RMSIT: -239.6±643.3%, p=0.042, RMET: -44.4±557.9%, p=1.0, SHAM: +121.4±513.1%; INTER: RMSIT: -186.3±210.9%, p=0.048, RMET: +36.0±273.1%, p=1.0, SHAM: +134.9±212.0%). No change was observed in muscle activity and deoxyhemoglobin of any muscle investigated. Further, changes in muscle activity and deoxyhemoglobin did not differ between groups at exhaustion.

Discussion/Conclusion

This study showed that 4 weeks of RMSIT and RMET improved IncRMT performance (WOB and test duration) compared to SHAM while changes in lung function and respiratory muscle strength did differ between groups. Improvements in IncRMT performance and changes in WOB during the training did not differ significantly between RMSIT and RMET groups even though the training volume of RMSIT was much lower than that of RMET. It seems that the combination of high pressures with high flows applied on in- and expiration, as with RMSIT, has similar effects on respiratory muscle endurance as RMET (including high flows and low pressures). This increase in respiratory muscle performance is in line with previous reported respiratory muscle endurance improvement after RMET measured with constant normocapnic hyperpnoea (Verges *et al.*, 2009). This similarity in improvements is in line with evidence from whole-body exercise training where that high intensity interval training was shown to elicit similar aerobic adaptations as traditional endurance training while the former was much lower in training volume (Weston *et al.,* 2014). The discrepancy in improvements of IncRMT performance with changes in MVV and respiratory muscle strength may result from training-specific adaptations and specificity of the performance test used, as suggested by Sales *et al.*, (2016). Since the IncRMT combines high flows, high pressures and a test duration of 14±5min, this test likely assesses the respiratory system in a more integrated and physiologically meaningful way than short (10-15s), intense measurements using only high flows (such as MVV) or maximal pressures assessed during brief maximal efforts (1.5s). In addition, the lower activity of STERNO during inspiration and INTER during expiration in RMSIT during the IncRMT may be a result of increased fatigue-resistance of respiratory accessory muscles and/or neurological adaptation improving the coordination of the recruitment of accessory respiratory muscles. The lack of a change in oxygen extraction is in contrast with the decrease in muscular activity but may possibly result from the fact that changes were too small to be detected with the NIRS method. In conclusion, 4 weeks of RMSIT and RMET show similar improvements in respiratory muscle-specific performance assessed during a novel incremental respiratory muscle endurance test, equal to established whole-body training regimens with similar differences in training intensity and duration.

References

Illi, S. K., Held, U., Frank, I., & Spengler, C. M. (2012). Effect of respiratory muscle training on exercise performance in healthy individuals: a systematic review and meta-analysis. *Sports Medicine (Auckland, N.Z.)*, *42*(8), 707–24

Sales, A. T. do N., Fregonezi, G. A. D. F., Ramsook, A. H., Guenette, J. A., Lima, I. N. D. F., & Reid, W. D. (2016). Respiratory muscle endurance after training in athletes and non-athletes: A systematic review and meta-analysis. *Physical Therapy in Sport : Official Journal of the Association of Chartered Physiotherapists in Sports Medicine*, *17*, 76–86

Smart, N. A., Giallauria, F., & Dieberg, G. (2013). Efficacy of inspiratory muscle training in chronic heart failure patients: A systematic review and meta-analysis. *International Journal of Cardiology*, *167*(4), 1502–1507

Verges, S., Renggli, A. S., Notter, D. a., & Spengler, C. M. (2009). Effects of different respiratory muscle training regimes on fatigue-related variables during volitional hyperpnoea. *Respiratory Physiology & Neurobiology*, *169*(3), 282–290

Weston, M., Taylor, K. L., Batterham, A. M., & Hopkins, W. G. (2014). Effects of low-volume high-intensity interval training (HIT) on fitness in adults: A meta-analysis of controlled and non-controlled trials. *Sports Medicine*, *44*(7), 1005–1017

Wüthrich, T. U., Marty, J., Benaglia, P., Eichenberger, P. A., & Spengler, C. M. (2015). Acute Effects of a Respiratory Sprint-Interval Session on Muscle Contractility. *Medicine and Science in Sports and Exercise*, *47*(9), 1979–1987

SGS/4S Young Investigator Award I Final Round

Title

Talent development in football: The early specialized bird catches the worm!

Authors/Affiliation

Roland Sieghartsleitner[1], _Claudia Zuber[1], Marc Zibung[1], Achim Conzelmann[1]_
[1]Institute of Sport Science, University of Bern, Switzerland

Abstract

Introduction

The identification and development of young football talents has become one of the most extensive research topics within sport science over the last decades. Whilst talent identification pursues the goal of recognizing young players with the potential to become elite athletes, talent development deals with an appropriate learning environment for these promising players (Williams & Reilly, 2000).

The essential role of sport participation from an early age on seems to be unquestionable within the process of talent development. Though this consensus statement, there is a major debate on the contents within this _early sport participation_: Is an initial phase with _sampling_ through various sporting activities superior to an _early specialization_ in a sport-specific domain (Ericsson, Krampe & Tesch-Römer, 1993; Côté, Baker & Abernethy, 2007)? The most important question related to this discussion is whether transfer effects throughout different sports and the postulated increase in intrinsic motivation from _sampling_ can compensate or even overshoot the loss in sport-specific practice volume? According to this topic, the significant impact of early sport-specific practice (up to 12 years of age) on adult performance levels has already been shown in junior national team players of the Swiss Football Federation (Zibung & Conzelmann, 2013).

Regarding the late adolescence, participating in elite youth football development programs (e.g. youth football academies or junior national teams) becomes more and more relevant for reaching elite levels in adult football. For example, almost 90% of all German Bundesliga players (seasons 2009/2010 to 2011/2012) have been involved in a youth elite academy for at least one season and around 60% of German U19 national team players become first league players (Güllich, 2014). In addition to the findings of Zibung and Conzelmann (2013), which dealt with the pathway from elite youth football to the adult level, it would therefore be interesting to know if sport-specific practice in the initial phase of the sports career also boosts the chances to even participate in elite youth football development programs. For that reason, the following contribution investigates the research question if Swiss junior national team football players made more sport-specific experiences up to 12 years of age than their less successful peers.

Methods

The sample consists of 294 talented football players from several regional youth squads throughout Switzerland (including 57 players with at least one nomination for the U15-U18 Swiss national teams; 19.4%). All of them were born in 1999 and have been part of the longitudinal study _talent selection and talent development in Swiss football_, which collects data from different dimensions to describe talent development holistically (e.g. motor performance, psychological aspects, external support).

Referencing to prior contributions within development-related issues in general and talent development in football respectively, a _person-oriented approach_ is used for data analysis (Bergman & El-Khouri, 2003; Zibung & Conzelmann, 2013). This approach is about searching for the most promising constellations of several variables within persons, which enables the opportunity of a non-linear compensation for weaknesses between single characteristics, compared to the _variable-oriented approach_ and its aiming for correlations between single predictor variables and success. As the _person-oriented approach_ requires a set of variables, the operationalization of the _early sport participation_ was determined through four variables: (1) volume of organized in-club football practice, (2) volume of free play within football, (3) volume of sports activities besides football and (4) the age at initial football club participation. All of them were collected with retrospective questionnaires, which asked the participants to report their sport behavior until the start of the longitudinal study at 12 years of age. Whenever participants have to cover a long period of time within retrospective questionnaires,

51

absolute values are of critical quality. On the other side reliability and validity have been proven to be acceptable, at least for well-remembered events (e.g. volume of practice; Hopwood, 2015).

The four above-mentioned variables defining the *early sport participation* were analyzed with the LICUR method (Bergman & El-Khouri, 2003). As common in person-oriented studies, this method uses a cluster analysis to group participants with similar variable constellations (Ward procedure; squared Euclidean distance). An initial analysis of residues led to the exclusion of 4 cases with unique variable constellations. After determining the number of clusters using the guidance by content and the elbow criterion, a partitioning cluster analysis was carried out to optimize the homogeneity within each cluster. Subsequent *transition analysis* deals with the identification of extraordinary successful groups. The number of transitions from each cluster to the U15-U18 Swiss national teams is counted and checked for significant differences compared to the expected numbers by means of a significance test based on the Fisher test and a binomial distribution ($p < .05$). All of this statistical procedures have been carried out using the statistical package SLEIPNER (Bergman & El-Khouri, 2002) and follow the recommendations for person-oriented studies (Bergman & El-Khouri, 2003; Bergman, Magnusson & El-Khouri, 2003).

Results

According to the total number of accumulated hours of practice and activities during *early sport participation* up to 12 years of age, Table I gives an overview throughout the entire sample. Sport-specific in-club practice only accounts for about 20% (1128h) of the total sports activity. The remaining 80% are almost equally split between free play (2058h) and activities besides football (1837h).

Table I. Descriptive statistics for the *early sport participation* (up to 12 years of age).

| | | early sport participation | | | | | | | |
| | | in-club practice (hours) | | free play (hours) | | sports activities besides football (hours) | | age at initial club participation (years) | |
		M	SD	M	SD	M	SD	M	SD
Overall	(*n* = 290)	1127.9	355.0	2058.3	1055.4	1836.7	1060.2	6.3	1.3
Cluster 1	(*n* = 25)	1304.2	269.7	4257.8	1404.4	1968.5	830.4	5.5	0.7
Cluster 2	(*n* = 56)	1602.4	229.8	1988.5	630.5	1736.9	821.9	5.4	0.9
Cluster 3	(*n* = 106)	1071.5	208.5	1694.9	633.4	1360.4	673.6	5.9	0.9
Cluster 4	(*n* = 42)	1091.1	217.2	2359.2	726.6	3592.7	863.5	6.4	0.7
Cluster 5	(*n* = 61)	743.2	202.6	1645.2	811.8	1493.0	721.0	7.9	1.2

The cluster analysis extracted a five pattern solution (cf. Table I, Figure I). Regarding the homogeneity coefficient (*HC*), clusters 2-5 show satisfactory values. Only cluster 1 seems to be somewhat critical. Despite reporting a huge amount of free play, some of this clusters cases could obviously prove consistency with the total sample by withstanding residue analysis.

As a consequence, the just mentioned cluster 1 is basically characterized by a huge amount of free play, which is around two standard deviations higher than average. In combination with a slightly increased amount of in-club practice, these *Football enthusiasts* show the highest number of sport-specific experiences overall. The 2nd cluster unites *Club players* with the earliest initial club participation and subsequent the highest amount of in-club practice. The largest group of *Average players* with barely any special characteristics was found in cluster 3. *Poly-sportive players* of cluster 4 have mostly focused on activities besides football, whereas *Football abstainers* (cluster 5) started their career later than their peers and didn´t participate that much in specific practice.

Regarding the transition analysis, two clusters show significant changes from expected values: *Football enthusiasts* have a 2.0-times increased chance to become selected for one of the U15-U18 Swiss national teams ($p < .05$). A significant lower chance to be selected has the group of *Football abstainers* (0.4-times; $p < .05$). Between this most and least successful groups do *Club players* (1.5-times), *Average players* (0.9-times) and the *Poly-sportive players* (0.8-times) not show any significant deviations from expected transitions.

Discussion/Conclusion

Based on the findings that a group of *Football enthusiasts* with the most sport-specific practice up to 12 years of age shows superior chances to be selected for junior national teams in Switzerland, the crucial role of early specialization within a sport-specific domain seems to be supported. In addition, the opposite cluster of *Football abstainers* with the least football practice has significantly reduced chances to get an essential support from this elite youth development program.
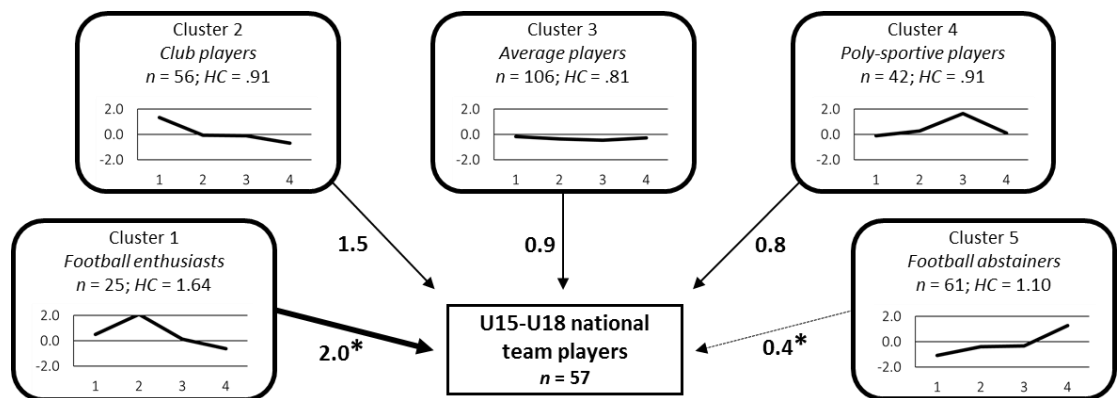

Figure 1. The resulting five clusters, their *z*-score profiles and chances for being selected to U15-U18 Swiss national teams (transition probability as multiple of the expected values; *p < .05; variables: 1 = in-club football practice; 2 = free play within football; 3 = sports activities besides football; 4 = age at initial football club participation; *HC* = Homogeneity coefficient, which gives the average squared Euclidean distance within a cluster).

Referencing to Zibung and Conzelmann (2013), fifteen years between the researched cohorts and the shift to a different level of talented players did not lead to any fundamental changes in terms of answering the present research question: sport-specific practice within *early sport participation* seems to be favorable. Although absolute values of the amount of practice have changed (more specific in-club practice and less free play in the present group), cluster analysis extract similar solutions in both samples. In fact, this supports the stability of the findings and the suitability of the used methods.

Although the practical implication of the present research definitely recommends sport-specific practice within *early sport participation*, this should not be understood as a claim for focused and sometimes monotonous deliberate practice. Quite the contrary, the most successful cluster of *Football enthusiasts* with its extraordinary amount in free play supports the hypothesis that a broad range of forms (e.g. different versions of football as futsal or beach soccer) and settings (e.g. free play or organized in-club practice) within early sport-specific football practice may lead to superior performance in the later career. Time will show if these consequences overlap with the shortly reconceptualized understanding of the *sampling hypothesis*. Côté and Erickson (2015) kept it open if *sampling* may not only mean participating in different sports, but also in different forms respective settings within the same sport. In the latter case the end of the *sampling vs. specializing debate* could be close, because former opposite counterparts would meet somewhere in the middle.

References

Bergman, L. R., & El-Khouri, B. M. (2002). *SLEIPNER - A statistical package for pattern-oriented analyses: User Manual*. Unpublished manuscript, Stockholm University.

Bergman, L. R., & El-Khouri, B. M. (2003). A person-oriented approach: Methods for today and methods for tomorrow. *New Directions for Child and Adolescent Development, 101*, 25-38.

Bergman, L. R., Magnusson, D., & El-Khouri, B. M. (2003). *Studying individual development in an interindividual context: A person-oriented approach*. *Paths through life: Vol. 4*. Mahwah, NJ: Erlbaum.

Côté, J., Baker, J., & Abernethy, B. (2007). Practice and Play in the Development of Sport Expertise. In G. Tenenbaum & R.C. Eklund (Eds.), *Handbook of Sport Psychology* (3rd Ed.) (pp. 184-202). Hoboken, NJ: John Wiley & Sons.

Côté, J., & Erickson, K. (2015). Diversification and deliberate play during the sampling years. In J. Baker & D. Farrow (Eds.), *Routledge Handbook of Sport Expertise* (pp. 305-316). Florence: Routledge.

Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review, 100*(3), 363-406.

Güllich, A. (2014). Selection, de-selection and progression in German football talent promotion. *European Journal of Sport Science, 14*(6), 530-537.

Hopwood, M. (2015). Issues in the collection of athlete training histories. In J. Baker & D. Farrow (Eds.), *Routledge Handbook of Sport Expertise* (pp. 156-165). Florence: Routledge.

Williams, A. M., & Reilly, T. (2000). Talent identification and development in soccer. *Journal of Sports Sciences, 18*, 657-667.

Zibung, M., & Conzelmann, A. (2013). The role of specialization in the promotion of young football talents: A person-oriented study. *European Journal of Sport Science, 13*(5), 452-460.

Sport science applied to professional and elite sport - Schneesport

Title

Trainerkarrieren im Schweizer Schneesport – Zum Zusammenhang von Anstellungsbedingungen und Fluktuation

Authors/Affiliation

Adler Zwahlen, J[1], Herzig, R[2], Piller, S[1], Läuppi, P[2], Nagel, S[1]
[1]Institut für Sportwissenschaft, Universität Bern, Schweiz
[2]Swiss-Ski, Muri bei Bern, Schweiz

Abstract

Introduction

Aktuelle Befunde zu Berufstrainerkarrieren im Spitzensport zeigen zwar eine allgemeine Zufriedenheit von TrainerInnen. Demgegenüber stehen jedoch die negative Einschätzung der beruflichen Belastung einschliesslich deren Folgen; sowie die Unzufriedenheit mit den Berufsbedingungen, wie etwa Einkommen, Arbeitszeiten und Aufstiegschancen (Digel et al., 2010). Cachay und Bahlke (2003) verweisen auf zentrale Herausforderungen einer Trainertätigkeit: die geringe Verberuflichung, ungenügende soziale Absicherung und begrenzte Vereinbarkeit mit anderen Rollen im Leben. Zusätzlich sind geschlechtsspezifische Unterschiede auszumachen: Frauen erfahren häufiger Ablehnung und Infragestellung ihrer Kompetenz im Vergleich zu ihren männlichen Arbeitskollegen.
Im Schweizer Schneesport sind aus Einzelfällen ähnliche Einschätzungen der beruflichen Belastung bekannt wie in den oben erwähnten Studien zu Berufstrainerkarrieren im Spitzensport. Da bisher noch keine Befunde zu Trainerkarrieren im Schweizer Schneesport existieren, wird in dieser Studie auf Grundlage berufssoziologischer Konzepte (z.B. Schlesinger, Studer & Nagel, 2015) folgender Fragestellung nachgegangen: Welche Bedeutung haben die Arbeitsbedingungen und die Zufriedenheit von Schneesporttrainern bei Swiss-Ski für eine dauerhafte Beschäftigung? Welche Gründe führen zu einem Ausstieg aus der Trainertätigkeit?

Methods

Die Datenerhebung erfolgt im Oktober und November 2016 anhand einer Online-Befragung (deutsch- und französischsprachig). Diese enthält Fragen zu aktuellen und vergangenen Anstellungsbedingungen, zum beruflichen Werdegang, zur Zufriedenheit, zu Erwartungen sowie Zukunftsplänen im Trainerberuf. Der Fragebogen wurde an 1200 aktuelle und ehemalige TrainerInnen von Swiss-Ski per Email versendet. Das Sample setzt sich sowohl aus regional als auch national tätigen TrainerInnen zusammen.

Results

Da die Datenauswertung erst im Dezember stattfinden wird, können noch keine abschliessenden Aussagen über die Resultate der Studie gemacht werden. Erste Analysen (*n* = 200) zeigen: Das persönliche Umfeld und Familie sowie der schlechte Verdienst werden als häufigste Gründe für einen Ausstieg als TrainerIn bei Swiss-Ski genannt.

Discussion/Conclusion

Die Resultate werden erstmals Befunde zu Trainerkarrieren im Schweizer Schneesport liefern. Sie sind insbesondere für Sportverbände relevant, in denen strukturelle Anpassungen gemäss den Resultaten erfolgen können. Durch eine Reduktion der Fluktuation im Trainerbereich können Wissen und Berufserfahrung nachhaltig gesichert und somit spitzensportliche Erfolge erreicht werden.

References

Bahlke, S. & Cachay, K. (2003). *Trainer… das ist halt einfach Männersache. Studie zur Unterrepräsentanz von Trainerinnen im Spitzensport.* Bergisch-Gladbach: Hansen.

Diegel, H., Thiel, A., Schreiner, R. & Waigel, S. (2010). *Berufsfeld Trainer im Spitzensport.* Schorndorf: Hoffmann.

Schlesinger, T., Studer, F. & Nagel, S. (2015). *Sportwissenschaftliches Studium und Beruf in der Schweiz*. Schorndorf: Hoffmann.

Title

The fusion of magneto-inertial sensors with low-cost GNSS can improve the accuracy of determining centre of mass kinematics in alpine ski racing

Authors/Affiliation

Benedikt Fasel[1], Jörg Spörri[2], Matthias Gilgien[3], Kamiar Aminian[1]

[1]Laboratory of Movement Analysis and Measurement, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Department of Sport Science and Kinesiology, University of Salzburg, Hallein-Rif, Austria; [3]Department of Physical Performance, Norwegian School of Sport Sciences, Oslo, Norway.

Abstract

Introduction

Obtaining accurate athletes' centre of mass (CoM) kinematics is crucial for better understanding performance and injury risk related aspects of alpine ski racing. For example, in a case study in giant slalom, CoM trajectory differences of 0.1m – 0.5m between the fastest and slowest runs of the same athlete were reported (Spörri, Kröll, Schwameder, & Müller, 2012). The golden standard for estimating CoM trajectories in-field is video-based 3D kinematics, a method based on multiple cameras filming the skier from different perspectives. However, corresponding experimental setups are complex, limited to small capture volumes and due to time-consuming manual digitising efforts not practicable for analysing a large number of runs. Therefore, recently alternative approaches based on global navigation satellite systems (GNSS) have emerged. Since GNSS only records the position of its antenna, for estimating the trajectory of the athlete's CoM additional processing is needed. For example, Gilgien et al. (2015) estimated CoM trajectory based on a pendulum model and reported an accuracy and precision of 0.09 m and 0.12 m, respectively. Supej (2010) proposed to fuse the GNSS with a full body inertial sensor suit estimating the athlete's posture, but did not quantitatively validate the system. Fasel, Spörri, Gilgien, et al. (2016) proposed a similar setup and reported an accuracy and precision of 0.08 m and 0.04 m, respectively. All those approaches have in common that they require a professional grade differential GNSS.

By the use of differential GNSS, antenna position can be obtained with an accuracy of below 5 cm (Gilgien, Spörri, Limpach, Geiger, & Müller, 2014); however, at the cost of requiring a reference base station. Thus, despite the advantage of allowing for the measurement of a large number of runs, corresponding setups are still relatively time consuming and, therefore, not well suited for routine measurements during daily training. An alternative option to overcome this limitation might be found in replacing the differential GNSS by a regular low-cost GNSS. However, the accuracy of low-cost GNSS of 2.5 m (Gilgien et al., 2014) is not sufficient for skiing measurements.

Therefore, the aims of this project were twofold: (i) to extend the work of Fasel, Spörri, & Aminian (2016), and to introduce a novel measurement system that fuses magneto-inertial sensors with the low-cost GNSS; (i) to validate the system in-field against a differential GNSS. The hypothesis of this study was that the accuracy of low-cost GNSS could be improved sufficiently by combination with other independent information sources.

Methods

Setup of the novel system: Athletes were equipped with inertial sensors (Physilog 4, Gait Up SA, Switzerland) fixed to their shanks, thighs, sacrum, sternum, C7, and head. They recorded acceleration and angular velocity at 500Hz. The sacrum sensor additionally contained a magnetometer (MLX 90393, Melexis, Belgium) sampling at 125Hz. The athletes then wore a customized back protector (P1-Dynamic, Ortema, Switzerland) with integrated GNSS antenna (TW2710, Tallysman, Canada) and an additional inertial sensor (Physilog 4) with integrated GNSS chip (u-blox M8, u-blox, Switzerland). Sampling frequency of the GNSS was 10Hz. Finally, a small magnet was buried at each gate of the skiing course. Magnet positions were surveyed with a differential GNSS.

Sensor fusion of the novel system: Three independent information sources were fused: 1) a body model with relative CoM obtained from the inertial sensors, 2) the antenna trajectory obtained with the low-cost GNSS, and 3) magnet positions. Fusion took place at the position of the GNSS antenna. Therefore,

56

in a first step, gravity-free acceleration in the global frame of the GNSS antenna was determined from the inertial sensors fixed to the trunk. For this purpose, sensor orientation was obtained with strap-down integration with motionless drift correction (Favre, Jolles, Siegrist, & Aminian, 2006). Measured acceleration of each sensor was converted to the global frame and the gravity component was removed. Then, each acceleration was translated to the GNSS antenna position. Finally, acceleration of the GNSS antenna was obtained by averaging between all sensors' accelerations. In a second step, GNSS antenna position at each gate crossing was determined. Each gate crossing was marked by a peak in the magnetic field intensity, caused by the local magnetic field distortion from the buried magnets (Fasel, Spörri, Kröll, & Aminian, 2016). After detecting these peaks the body model from Fasel, Spörri, Gilgien, et al. (2016) was used to estimate the distance between the magnet and GNSS antenna position. To this end it was assumed that the position of the left (right) Antero-Superior Iliac Spine (LASIS) would match the magnet's position at gate crossing during a left (right) turn. The position of the GNSS antenna was computed as the sum of the absolute magnet position and the distance between LASIS (RASIS) and the GNSS antenna. Information fusion was achieved by applying an Extended Kalman Smoother twice. During the first run, acceleration was fused with GNSS antenna trajectory. During the second run, the magnet positions were added to the filter. Finally, GNSS antenna trajectory was translated to the athlete's CoM estimated based on the model described in (Fasel, Spörri, Gilgien, et al., 2016).

Reference system: The antenna for the differential GNSS (G5Ant-2AT1, Torrance, Canada) was fixed to the athlete's helmet while the receiver (Alpha-G3T, Javad, San Jose, USA) was worn in a backpack. Reference antenna trajectory was obtained at 10Hz and interpolated to 500Hz using a spline filter. The system was synchronized with the inertial sensors using cross-correlation. Athlete CoM trajectory was estimated using the same body model as with the inertial-sensor based system (Fasel, Spörri, Gilgien, et al., 2016).

System comparison: For validation purposes, one European-Cup level athlete skied a 30 gates giant slalom course twice. Accuracy was defined as the mean difference between the proposed system's CoM trajectory and reference trajectory along each spatial axis. Precision was defined as the standard deviation of this difference.

Results

For each axis, accuracy and precision for determining a skier´s CoM trajectory were found to be <0.5m and <0.15m, respectively (Table 1).

	Accuracy (Precision) Easting	Accuracy (Precision) Northing	Accuracy (Precision) Elevation
Run 1, m	0.39 (0.11)	-0.33 (0.15)	-0.05 (0.04)
Run 2, m	0.47 (0.10)	-0.29 (0.13)	-0.04 (0.03)

Table 1: Accuracy and precision of two runs.

Discussion/Conclusion

Fusing information from three different sources (i.e. inertial sensors, magnetometers, low-cost GNSS) allowed improving the accuracy and precision of a skier´s CoM trajectory, compared to a low-cost GNSS measurement only. Based on the proposed method, it was possible to entirely remove the time-dependent drift in accuracy due to changes of satellite constellation and atmospheric disturbances, which is known to be a major problem of low-cost GNSS (Misra & Enge, 2011). Even though the accuracy was still in the decimetre range, it remained approximately constant between both runs. Thus, a between-run analysis of skiing trajectory can be considered appropriate. Errors were larger in the horizontal plane. A possible explanation could be the inaccurate estimation of the magnet position based on the hypothesis that LASIS or RASIS would match magnet positions during gate crossing. Estimation of the distance between LASIS or RASIS and the magnet based on the measured peak magnetic intensity could help improving the results. Another reason for higher errors in the horizontal plane could be the system's time resolution. When skiing at 90 km/h for instance, the magnetometer's sampling rate of 125Hz samples once every 0.2 m. Thus, already a slight inaccuracy in peak detection (e.g. one or two samples) leads to a position error of at least 0.2 m.

57

A major drawback of the current setup was that the magnet positions needed to be determined using a differential GNSS. While the setup for the athletes became easier, a partial use of differential GNSS was still required. However, instead of using reference magnet positions, their positions could be estimated based on the skiing trajectory obtained after the first run of the Kalman smoother: for multiple runs on the same course, since gate crossing times are known and happen always at the same location, average magnet positions can be computed. Under the hypothesis that GNSS errors are independent between runs, precise magnet positions could therefore be obtained and used in the second run of the Kalman smoother. Although absolute offset may not be completely removed, the relative offset between all runs would be removed, allowing between-run skiing trajectory comparisons. Alternatively, a 3D terrain model of the skiing slope and gates could be constructed from drone images and magnet positions obtained from this model (Fasel, Spörri, & Aminian, 2016).

As illustrated in this study, a fusion of low-cost GNSS with inertial and magnetic sensors can help to improve the accuracy of determining centre of mass kinematics in alpine ski racing. In addition to that, the 3D body model allows computing an athlete's joint angles and the detected gate crossings could be used for a gate-to-gate timing and turn cycle structure analysis (Falbriard, Fasel, Spörri, & Aminian, 2016). With all this information at hand, the system may help to provide a better understanding of performance and injury risk related aspects of alpine ski racing.

References

Falbriard, M., Fasel, B., Spörri, J., & Aminian, K. (2016). A ski racer's turn cycle structure depends on slope inclination, speed and gate offset. In *Abstract Book of the International congress on science and skiing 2016*.

Fasel, B., Spörri, J., & Aminian, K. (2016). Improving the accuracy of low-cost GNSS by fusion with inertial and magnetic sensors in alpine ski racing. In *34th International Conference on Biomechanics in Sports*. Tsukuba.

Fasel, B., Spörri, J., Gilgien, M., Boffi, G., Chardonnens, J., Müller, E., & Aminian, K. (2016). Three-Dimensional Body and Centre of Mass Kinematics in Alpine Ski Racing Using Differential GNSS and Inertial Sensors. *Remote Sensing*, *8*(671). http://doi.org/10.3390/rs8080671

Fasel, B., Spörri, J., Kröll, J., & Aminian, K. (2016). Alpine Ski Racing Gate Crossing Detection Using Magnetometers. In *Abstract Book of the International congress on science and skiing 2016*.

Favre, J., Jolles, B. M., Siegrist, O., & Aminian, K. (2006). Quaternion-based fusion of gyroscopes and accelerometers to improve 3D angle measurement. *Electronics Letters*, *42*(11), 612. http://doi.org/10.1049/el:20060124

Gilgien, M., Spörri, J., Chardonnens, J., Kröll, J., Limpach, P., & Müller, E. (2015). Determination of the centre of mass kinematics in alpine skiing using differential global navigation satellite systems. *Journal of Sports Sciences*, *33*(9), 960–969. http://doi.org/10.1080/02640414.2014.977934

Gilgien, M., Spörri, J., Limpach, P., Geiger, A., & Müller, E. (2014). The effect of different Global Navigation Satellite System methods on positioning accuracy in elite alpine skiing. *Sensors (Basel, Switzerland)*, *14*(10), 18433–53. http://doi.org/10.3390/s141018433

Misra, P., & Enge, P. (2011). *Global Positioning System: Signals, Measurements, and Performance* (Revised Second Edition). Lincoln, MA: Ganga-Jamuna Press.

Spörri, J., Kröll, J., Schwameder, H., & Müller, E. (2012). Turn Characteristics of a Top World Class Athlete in Giant Slalom: A Case Study Assessing Current Performance Prediction Concepts. *International Journal of Sports Science and Coaching*, *7*(4), 647–660. http://doi.org/10.1260/1747-9541.7.4.647

Supej, M. (2010). 3D measurements of alpine skiing with an inertial sensor motion capture suit and GNSS RTK system. *Journal of Sports Sciences*, *28*(7), 759–69. http://doi.org/10.1080/02640411003716934

Sport science applied to professional and elite sport - Schneesport

Title

Vibrationsabhängige Sehleistungsunterschiede von Schweizer Ski-Nachwuchsathlet/innen im Vergleich zu Ski-Nordisch-Nachwuchsathlet/innen und Normalschüler/innen

Authors/Affiliation

Ralf Kredel[1], Adrian Grimm[1] & Ernst-Joachim Hossner[1]
[1]_Institut für Sportwissenschaft, Universität Bern, Bern, Schweiz_

Abstract

Introduction

Im Skirennsport ist der Ausgleich der durch Pistenunebenheiten erzeugten Erschütterungen essentiell für die Aufrechterhaltung eines stabilen Oberkörpers und damit für das Erreichen guter Wettkampfleistungen. Bewegungsseitig geschieht der Ausgleich von Erschütterungen durch die Einnahme einer reaktionsbereiten Körperhaltung und eine optimale Einstellung der Gelenkssteifigkeiten. Die aktuelle Forschung lässt zudem vermuten, dass eine gute Oberkörperstabilität auch dazu dient, den Kopf und somit die Augen ruhig zu halten, um auf diese Weise die Aufnahme visueller Informationen zu optimieren (vgl. Kredel, Grimm & Hossner, 2013). Im hier berichteten Teilprojekt wurde untersucht, ob und in welchem Ausmass sich Schweizer Nachwuchs-Skifahrer/innen gegenüber in Bezug auf Alter und Geschlecht vergleichbaren leistungsorientiert trainierenden ski-nordischen Nachwuchsathlet/innen sowie gegenüber Normal-Schüler/innen durch eine bessere Aufrechterhaltung der Sehleistung unter Vibrationsbedingungen auszeichnen.

Methods

Im Rahmen zweistündiger Einzeltests an der Sportmittelschule Engelberg und im Verhaltenslabor des ISPW Bern wurden mit einem Skisimulator realitätsnahe Erschütterungen erzeugt und gleichzeitig die resultierende Sehleistung (Landolt Visual Acuity) der Versuchsteilnehmer/innen mittels des Freiburg Visual Acuity Tests (FrACT) erfasst. Die Teilnehmer/innen standen mit Skischuhen in Skibindungen auf dem Skisimulator und konnten eine individuelle Körperhaltung einnehmen, die während des gesamten Tests mittels eines Bewegungserfassungssystems (10x Vicon T-20s, 500 Hz) aufgezeichnet wurde. Die zwölf induzierten Vibrationsbedingungen unterschieden sich in Frequenz (1.2 Hz, 2.4 Hz, 3.6 Hz), Links/Rechts-Seitengleichheit (identisch, variiert) und Prädizierbarkeit (prädizierbar, zufällig) der Erschütterungen und wurden in balancierter Reihung mit jeweils vor- und nachgeschaltetem Ruhetest den 80 Versuchsteilnehmer/innen (40 Ski, 20 Nordisch, 20 Normal, ♀=50%) präsentiert. Nach jedem Test wurde das subjektive Belastungsempfinden (Borg) abgefragt und zwei Minuten pausiert. Sehleistungsunterschiede zum Mittelwert der Ruhetests (Δlogmar) wurden durch eine messwiederholt ANOVA (within: Frequenz, Seitengleichheit, Prädizierbarkeit; between: Gruppe) unterschiedsgeprüft.

Results and Discussion

Erste Analysen zeigen, dass die Versuchsteilnehmer/innen ihre Sehleistung je nach Vibrationsfrequenz unterschiedlich gut aufrechterhalten konnten, $F(2,114) = 51.44$, $p = .000$, $\eta_p^2 = .488$, wobei die Verschlechterung der Sehleistung mit zunehmender Frequenz zunahm: 1.2 Hz ($M = .02$, $SD = .05$), 2.4 Hz ($M = .04$, $SD = .05$) und 3.6 Hz ($M = .08$, $SD = .07$). Zudem zeigte sich eine signifikante Interaktion von Frequenz und Gruppe auf die Sehleistung, $F(4,114) = 3.995$, $p = .005$, $\eta_p^2 = .129$, die auf einen relativen Sehleistungsunterschied zwischen der Nordischen-, $M = .06$, $SD = .07$, und der Normalschüler/innen-Gruppe, $M = .10$, $SD = .07$, bei der höchsten Frequenz zurückzuführen ist. Zwar fielen die mittleren absoluten Sehleistungen über alle Vibrationsbedingungen bei den Skifahrer/innen, $M = -.11$, $SD = .05$, in der Tendenz besser aus, Nordisch: $M = -.06$, $SD = .10$, Normal: $M = -.07$, $SD = .09$, trotzdem zeigt diese Gruppe im Vergleich keine bessere Aufrechterhaltung der Sehleistung unter Vibrationsbedingungen. Es ist daher eher davon auszugehen, dass die Aufrechterhaltung der Sehleistung an die Kopf- bzw. Oberkörperstabilität gekoppelt ist, die Personen abhängig von Ihrer - nicht unmittelbar an die Ski-Expertise gekoppelten - Dämpfungskompetenz unterschiedlich gut aufrechterhalten können. Aktuell werden aus den erfassten Bewegungsdaten Dämpfungskompetenz-werte ermittelt, die das individuelle Leistungsniveau der Versuchsteilnehmer/innen unter Berücksichtigung biomechanischer Parameter erfassen und die in einem nachfolgenden Auswerteschritt in Bezug zu den Sehleistungsunterschieden gesetzt werden sollen.

59

References

Kredel, R., Grimm, A., & Hossner, E.-J. (2013). Vibrations, Posture, and the Stabilization of Gaze: An Experimental Study on Impedance Control. In F. Mess, M. Gruber & A. Woll (Hrsg.), *21. Sportwissenschaftlicher Hochschultag - Sportwissenschaft grenzenlos?! Schriften der Deutschen Vereinigung für Sportwissenschaft: Vol. 230* (S. 217). Hamburg: Czwalina.

Exercise is medicine

Title
Exercise and Cancer – State of the Art

Authors/Affiliation
Fiona Streckmann[1,2,3]
[1]Department of Sport, Exercise and Health, University of Basel, Switzerland
[2]Department of Oncology, University Hospital of Basel, Switzerland
[3]Institute of Cardiovascular Research and Sport medicine, German Sport University Cologne, Germany

Abstract

Every year, 39.500 people are diagnosed with cancer in Switzerland [1]. The direct toxic effect of anti-cancer treatment as well as deconditioning due to higher immobility, can induce many debilitating side-effects, not only influencing patients' autonomy and quality of life but also their medical treatment and consequently overall survival.

Until 35 years ago, patients were advised to rest. Meanwhile, there has been a paradigm shift as evidence suggests that physical activity plays a vital role in cancer prevention and control. The preventive effect of exercise on the incidence of breast, colon- and endometrial cancer has been verified [2]. Furthermore, current literature shows that physical activity is not only safe and feasible for patients undergoing or recovering from cancer treatment, but also highly beneficial for many side-effects of the medical treatment. We have evidence for the improvement of the aerobic capacity, muscle strength, body composition, urinary incontinence, fatigue and quality of life in breast-, prostate- and hematologic cancer survivors. It has furthermore been shown that resistance training is feasible and safe for breast cancer patients with lymphedema[3]. Specific neuromuscular exercises have even proved promising to tackle the symptoms of Chemotherapy-induced peripheral neuropathy, a highly prevalent and clinically relevant side-effect of neurotoxic chemotherapy with currently no treatment option[4].

In Conclusion, the potential of physical activity is immense and still rather underestimated. It should therefore receive far more attention as a part of supportive therapy in oncology. Like for cardio patients, exercise should be prescribed for any cancer patient in order to maintain and regain physical functions and associated quality of life.

References

[1] NICER – National Institute for Cancer Epidemiology and Registration, www.nicer.org, November 2016

[2] Friedenreich, C.M., Neilson, H.K., Lynch, B.M. (2010). State of the epidemiological evidence on physical activity and cancer prevention. Eur J Cancer, 46(14), 2593-604.

[3] Schmitz, K.H. et al., (2010). Amercian College of Sports Medicine Roundtable on Exercise Guidelines for Cancer Survivors. Med Sci Sports Exerc., 42(7), 1409-26.

[4] Streckmann, F. et al. (2014). Exercise program improves therapy-related side-effects and quality of life in lymphoma patients undergoing therapy. Ann Oncol., 25(2), 493-9.

61

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Exercise is medicine

Title

Exercise effects on stem cells - new evidence for health and disease

Authors/Affiliation

Julia M. Kröpfl, Christina M. Spengler

Exercise Physiology Lab, Institute of Human Movement Sciences and Sport, ETH Zurich, Switzerland

Abstract

In recent years, evidence was growing that physical exercise has an influence on bone-marrow (BM) as well as circulating hematopoietic stem and progenitor cells (CPCs) in peripheral blood. Exercise intensity and duration are important determinants of circulating HPC number and proliferative capacity, similar to factors such as environmental stress or acute events like myocardial infarction (MI).

Triggers of exercise-induced CPC kinetics and mobilization are not fully understood. On the one hand, studies found an increased CPC number shortly after exhaustive, short-duration exercise in normoxic, normobaric conditions (Emmons et al., 2016; Kroepfl et al., 2012). This increase was shown to be related to increased oxidative stress (Kroepfl et al., 2012) and paracrine factors released from BM mesenchymal stromal cells (Emmons et al., 2016). At the same time, CPC proliferative capacity was significantly reduced, likely caused by exercise-induced sympathetic stress (Kropfl et al., 2014). This could imply that exercise-induced stress leaves more differentiated progenitors with less self-renewal capacity in circulation, possibly due to homing of 'young' CPCs from circulation to peripheral, possibly regenerating, tissue (Emmons et al., 2016). On the other hand, after long-duration exercise at low intensity, such as an ultra-endurance bike race, CPC number was unchanged while CPC proliferative capacity was reduced. Thus, ultra-endurance exercise-induced stress either changes the composition of CPCs or effects CPC survival, differentiation and/or proliferative capacity (Stelzer et al., 2014).

Environmental conditions with enhanced oxidative and sympathetic stress (e.g. very high altitudes >3500 m above sea level) are expected to trigger an even greater response, but interestingly, hypoxia-induced CPC number declined and 2 hours of increasingly vigorous exercise did not counteract this effect (unpublished results). Possibly, constant oxidative stress combined with increased sympathetic activity leads to suppression of progenitor cell mobilization.

While intense exercise may cause intermittent ischemia in the working muscle, acute ischemia of longer duration is present with MI which was also shown to elicit an increase in CPC number within the first week after infarction while CPC count as well as proliferative capacity remained unchanged in the post-acute phase. This emphasizes the importance of the body's self-regenerative potential after an acute event like MI. Astonishingly, cardiac contractile function after MI was negatively related to baseline CPC number, which suggests a potential to predict post-infarction outcome (unpublished results), in line with the hypothesis that baseline progenitor cell number might predict future metabolic deterioration in healthy individuals (Fadini et al., 2015). Thus, one could speculate that a lower baseline number of CPCs, associated with better metabolic health and better outcome after MI, implies steady-state regeneration with no additional mobilization, leaving less CPCs in circulation.

Increasing the understanding of the mechanisms involved in changing CPC number and proliferative capacity with stressors like acute exercise, hypoxia, ischemia or disease will help to optimize and personalize training protocols for healthy subjects as well as patients in favor of the best preventive and regenerative effects.

References

Emmons, R., Niemiro, G. M., Owolabi, O., & De Lisio, M. (2016). Acute exercise mobilizes hematopoietic stem and progenitor cells and alters the mesenchymal stromal cell secretome. _J Appl Physiol (1985), 120_(6), 624-632. doi:10.1152/japplphysiol.00925.2015

Fadini, G. P., Bonora, B. M., Marcuzzo, G., Marescotti, M. C., Cappellari, R., Pantano, G., Sanzari, M. C., Duran, X., Vendrell, J., Plebani, M., & Avogaro, A. (2015). Circulating Stem Cells Associate

Exercise is medicine

With Adiposity and Future Metabolic Deterioration in Healthy Subjects. *J Clin Endocrinol Metab, 100*(12), 4570-4578. doi:10.1210/jc.2015-2867

Kroepfl, J. M., Pekovits, K., Stelzer, I., Fuchs, R., Zelzer, S., Hofmann, P., Sedlmayr, P., Dohr, G., Wallner-Liebmann, S., Domej, W., & Mueller, W. (2012). Exercise increases the frequency of circulating hematopoietic progenitor cells, but reduces hematopoietic colony-forming capacity. *Stem Cells Dev, 21*(16), 2915-2925. doi:10.1089/scd.2012.0017

Kropfl, J. M., Stelzer, I., Mangge, H., Pekovits, K., Fuchs, R., Allard, N., Schinagl, L., Hofmann, P., Dohr, G., Wallner-Liebmann, S., Domej, W., & Muller, W. (2014). Exercise-induced norepinephrine decreases circulating hematopoietic stem and progenitor cell colony-forming capacity. *PLoS One, 9*(9), e106120. doi:10.1371/journal.pone.0106120

Stelzer, I., Kropfl, J. M., Fuchs, R., Pekovits, K., Mangge, H., Raggam, R. B., Gruber, H. J., Pruller, F., Hofmann, P., Truschnig-Wilders, M., Obermayer-Pietsch, B., Haushofer, A. C., Kessler, H. H., & Machler, P. (2014). Ultra-endurance exercise induces stress and inflammation and affects circulating hematopoietic progenitor cell function. *Scand J Med Sci Sports*. doi:10.1111/sms.12347

Exercise is medicine

Title

Low objectively assessed vigorous-intensity physical activity is associated with increased adrenocortical reactivity to psychosocial stress in students with high stress perceptions

Authors/Affiliation

Markus Gerber[1], Sebastian Ludyga[1], Manuel Mücke[1], Flora Colledge[1], Serge Brand[1,2], Uwe Pühse[1]

[1]Department of Sport, Exercise and Health, Sport Science Section, University of Basel, Basel, Switzerland, [2]Center for Affective, Stress and Sleep Disorders, Psychiatric Clinics of the University of Basel, Basel, Switzerland

Abstract

Introduction

The pathways by which physical activity impacts on participants' health are still not fully understood (Gerber & Pühse, 2009; Gerber, Börjesson, Ljung, Lindwall, & Jonsdottir, 2016; Stults-Kolehmainen & Sinha, 2014). The purpose of the present study was to go beyond existing research by combining methods from survey-based and experimental stress research (Gerber et al., 2014; Kasten & Fuchs, in press) and by examining whether the potential of vigorous physical activity (VPA) to attenuated physiological and psychological stress responses is moderated by participants' subjective stress perceptions.

Methods

The sample consisted of 42 undergraduate students (*M*=21.2 years, 52% women). Participants self-reported their stress and wore an accelerometer device for seven consecutive days. To examine differences in the adrenocortical, autonomic and psychological stress reactivity, salivary free cortisol, heart rate, state anxiety, mood and calmness were assessed prior, during and after the Trier Social Stress Test (TSST). The cut-offs of the American College of Sports Medicine (ACSM) were used to distinguish between students below/above current VPA recommendations.

Results

High levels of perceived stress combined with VPA levels below the ACSM's standards (< 3x 20min/week) were associated with an increased salivary cortisol response to the TSST (*p*<.05). Importantly, the differences in cortisol reactivity remained after adjusting for age, sex, and BMI. No significant group differences existed for heart rate. However, students with high stress/low VPA experienced less favourable affect throughout the entire testing session (*p*<.05).

Discussion/Conclusion

Our study suggests that VPA has the highest stress-protective potential among undergraduate students with high stress levels. Our findings highlight that promoting VPA in young adults seems to be a promising strategy to increase physiological and psychological stress resilience.

References

Gerber, M., & Pühse, U. (2009). *Do exercise and fitness protect against stress-induced health complaints? A review of the literature. Scandinavian Journal of Public Health, 37, 801-819.*

Gerber, M., Börjesson, M., Ljung, T., Lindwall, M., & Jonsdottir, I. (2016). *Fitness moderates the relationship between stress and cardiovascular risk factors. Medicine and Science in Sports and Exercise.*

Gerber, M., Brand, S., Herrmann, C., Colledge, F., Holsboer-Trachsler, E., & Pühse, U. (2014). *Increased objectively assessed vigorous-intensity exercise is associated with reduced stress, increased mental health and good objective and subjective sleep in young adults. Physiology and Behavior, 135, 17-24.*

Kasten, N., & Fuchs, R. (in press). *Methodische Aspekte der Stressforschung. In R. Fuchs & M. Gerber (Eds.), Stressregulation und Sport. Heidelberg: Springer.*

Stults-Kolehmainen, M. A., & Sinha, R. (2014). *The effects of stress on physical activity and exercise. Sports Medicine, 44(1), 81-121. doi:10.1007/s40279-013-0090-5*

Soziale Faktoren des Sport- und Bewegungsverhaltens

Title

Soziale Faktoren des Sport- und Bewegungsverhaltens

Authors/Affiliation

Siegfried Nagel[1], Markus Lamprecht[2]

[1] Institute of Sport Science, University of Bern, Switzerland

[2] Lamprecht und Stamm Sozialforschung und Beratung AG, Zürich, Switzerland

Abstract

Einführung

Sport- und Bewegungsaktivitäten wird ein grosses Potential bei der Bewältigung wichtiger Gegenwartsprobleme in den Bereichen Gesundheit, Bildung und soziale Integration zugeschrieben. Damit die möglichen Effekte wirksam werden können, ist es jedoch notwendig, dass ein breiter Teil der Bevölkerung regelmässig und dauerhaft Sport treibt und sich bewegt. Trotz vielfältiger Initiativen und Konzepte im Bereich der Sport- und Bewegungsförderung bestehen allerdings nach wie vor soziale Ungleichheiten hinsichtlich der Sportbeteiligung in der Schweiz. Die aktuellen Sportverhaltensstudien machen deutlich (z.B. Lamprecht, Fischer & Stamm, 2014), dass z.B. Menschen mit geringerer Bildung, aus lateinischen Sprachregionen, mit Migrationshintergrund oder mit Behinderungen hinsichtlich der Sportbeteiligung und insbesondere in Sportvereinen unterrepräsentiert sind. Zur differenzierten Analyse dieses Phänomens erscheint die isolierte Betrachtung einzelner Parameter der sozialen Ungleichheit nicht ausreichend zu sein, sondern es sind u.a. auch die bewegungsrelevanten Rahmenbedingungen im Wohnumfeld, sozio-kulturell geprägte Wertvorstellungen (z.B. Sportverständnis) sowie spezifische Strukturbedingungen im kommunalen Kontext (z.B. Sportinfrastruktur, Sportvereine) in den Fokus zu rücken.

Im Kontext dieser Problemstellung beleuchten die drei Vorträge des Arbeitskreises je spezifische Zielgruppen und relevante soziale Faktoren des Sport- und Bewegungsverhaltens.

Überblick Präsentationen

Bürgi et al. zeigen auf, wie sich Primarschulkinder aus Nachbarschaften mit unterschiedlichem sozioökonomischen Status in ihrem räumlichen Bewegungsverhalten unterscheiden. Dafür werden Daten einer kombinierten Aktivitätsmessung mittels GPS und Accelerometrie herangezogen und analysiert, ob die Kinder unterschiedliche Orte nutzen, um körperlich aktiv oder inaktiv zu sein.

Der Beitrag von Hayoz et al. beleuchtet das Phänomen, dass junge Menschen in der Romandie weniger sportlich aktiv sind als in der Deutschschweiz. Dabei werden sowohl die Bedeutung struktureller Rahmenbedingungen im kommunalen Kontext (z.B. Sportinfrastruktur, Sportangebot) als auch die Relevanz sportbezogener Handlungsorientierungen auf individueller Ebene analysiert.

Klenk et al. untersuchen förderlich bzw. restriktive Bedingungen der Teilhabe von Menschen mit Behinderungen in Sportvereinen. Hierzu analysieren sie verschiedene strukturbezogene Rahmenbedingungen in eigenständigen Behindertensportgruppen einerseits und gemischten Sportvereinsgruppen andererseits.

References

Lamprecht, M., Fischer, A., & Stamm, H. P. (2014). *Sport Schweiz 2014: Sportaktivität und Sportinteresse der Schweizer Bevölkerung* [Sports in Switzerland 2014: Sports activities and interest in sports among the Swiss population]. Magglingen: Bundesamt für Sport.

Soziale Faktoren des Sport- und Bewegungsverhaltens

Title

Spatial physical activity patterns among primary school children living in neighbourhoods of varying socioeconomic status: a cross-sectional study using accelerometry and Global Positioning System

Authors/Affiliation

Rahel Bürgi[1,2], Laura Tomatis[1], Kurt Murer[1], Hanspeter Stamm[2], Eling D. de Bruin[1]

[1]Department of Health Sciences and Technology, Institute of Human Movement Sciences and Sport, ETH Zurich, Zurich Switzerland

[2]Lamprecht & Stamm, Sozialforschung und Beratung AG, Zurich, Switzerland

Abstract

Introduction

Along with the increased use of ecological models in physical activity (PA) research and public health [1], researchers have recently begun to focus more on the environment in which people live. As a result, the neighbourhood has been recognized as an important correlate of PA [2]. Different studies could show that neighbourhood socioeconomic status (SES) may influence resident's PA independent of individual SES [2,3]. However, results about the association between neighbourhood SES and PA and physical inactivity among children are ambiguous. Particularly, it is unknown how socioeconomic factors influence the spatial context of children's moderate-vigorous physical activity (MVPA) and sedentary behaviour (SB). This study aimed to investigate by means of Global Positioning System (GPS) and accelerometry whether locations where children engage in MVPA and SB differ by neighbourhood SES.

Methods

Participants included 83 children aged 7–9 from nine public schools located in a low- and high-SES area in Zurich, Switzerland. Children wore an accelerometer and GPS sensor for seven consecutive days during a regular school week between May and June 2014. Time-matched accelerometer and GPS data was mapped with a geographic information system and each data point was assigned to one of eight activity settings. The amount (in min) and proportion (in %) of time spent in MVPA and SB were calculated for every setting. To investigate differences between the two SES groups, multilevel analyses accounting for the hierarchical structure of the data were conducted.

Results

Both SES groups achieved most minutes in MVPA at own school, on streets and at home and recorded the highest proportions of MVPA in recreational facilities, streets and other schools. The highest amounts and proportions of SB were found at home and own school. High-SES children accumulated significantly more minutes in MVPA and SB in parks, sport facilities, other schools and streets, while the low-SES group spent more time in both activities in other places. When taking the total time spent in a setting into account and using the proportion of MVPA or SB, the only differences between the two groups were found at other schools and outside the city, where the high-SES children showed a significantly higher activity level (p-values <0.001).

Discussion/Conclusion

Several differences in the spatial activity pattern between children from low- and high-SES neighbourhoods were found, independent of their individual SES. The findings seem to highlight the importance of providing safe streets and access to appropriate types of recreational facilities to reach recommended PA levels, especially in low-SES neighbourhoods. Moreover, further policies to reduce SB within home and school environment are needed in both low- and high-SES neighbourhoods.

References

[1] Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J. F., & Martin, B. W. (2012). Correlates of physical activity: why are some people physically active and others not? *Lancet, 380*, 258-271.

[2] McNeill, L. H., Kreuter, M. W., & Subramanian, S. V. (2006). Social environment and physical activity: a review of concepts and evidence. *Soc Sci Med, 63*(4), 1011-1022.

Soziale Faktoren des Sport- und Bewegungsverhaltens

[3] Kavanagh, A. M., Goller, J. L., King, T., Jolley, D., Crawford, D., & Turrell, G. (2005). Urban area disadvantage and physical activity: a multilevel study in Melbourne, Australia. J Epidemiol Community Health, 59(11), 934-940.

Soziale Faktoren des Sport- und Bewegungsverhaltens

Title

The importance of structural factors and individual orientations for the sports participation of youth – a comparison between German and French-speaking municipalities in Switzerland

Authors/Affiliation

Christelle Hayoz[1], Claudia Klostermann[1], Torsten Schlesinger[2], Siegfried Nagel[1]
[1] Institute of Sport Science, University of Bern, Switzerland
[2] Institute of Human Movement Science, Chemnitz University of Technology, Germany

Abstract

Introduction

Sport participation in the Swiss population differs considerably depending on the linguistic region. The German-speaking population shows a higher sports activity than French or Italian-speaking citizens of Switzerland (Lamprecht, Fischer, & Stamm, 2014). This study analyses how different structural conditions in the municipalities (e. g. sports facilities, significance of the municipal promotion of sports) and sports-related orientations of individuals (e. g. sports- and body-related thought and behaviour orientations) across the German and French-speaking regions of Switzerland correlate with sport participation of adolescents and young adults.

Methods

According to the theory of social action (Coleman, 1994), individual behaviour is not only determined by the individual, but also by the structural factors in which a person is socially embedded. In order to identify possible structural factors, a written survey and a qualitative interview were conducted with municipal sport leaders (n = 36) in German and French-speaking municipalities. In addition, sports providers in the selected municipalities (n = 294) completed an online survey about their sports offer. Individual factors pertaining to adolescents and young adults, such as sports behaviour, the perception of structural characteristics in the municipality and thought and behaviour orientations related to sports and the body, were collected through an online survey of the 15- to 30-year-old population (N = 4'039, M_{age} = 21.5, SD_{age} = 4.64).

Results

Sports participation and the relative number of club memberships is significantly higher in German-speaking municipalities (84%) compared to the French-speaking ones (76.1%) (Chi^2 (1, N = 4'039) = 34.317, p < .001). This difference corresponds to the greater importance of local sports policy in German-speaking municipalities (M = 3.29) compared to the French-speaking municipalities (M = 3.00). On the individual level, adolescents and young adults in the French-speaking municipalities are less satisfied with the opportunities to be physically active in the environment (t(2938) = 7.311, p < .001) and commute more often to another municipality to practice their main sports activity. In addition, the inhabitants of German-speaking municipalities push themselves more to their limits in sports (t(3628) = 2.8, p < .01), give more importance to their body appearance _(t(3631) = 7.798, p < .001)_ and feel better in their bodies during sports activities (t(3627) = -4.325, p < .001) than their counterparts in the French-speaking areas.

Discussion/Conclusion

These findings show that structural conditions in municipalities as well as the youth's individual perception and individual sports-related orientations may be relevant for the sports participation of adolescents and young adults. However, it must be noted that further research, such as a multilevel analysis, is needed to more precisely analyse linguistic differences in sports participation in Switzerland.

References

Coleman, J. S. (1994). _Foundations of social theory_. Cambridge, MA: Belknap Press of Harvard University Press.

Lamprecht, M., Fischer, A., & Stamm, H. P. (2014). _Sport Schweiz 2014: Sportaktivität und Sportinteresse der Schweizer Bevölkerung_ [Sports in Switzerland 2014: Sports activities and interest in sports among the Swiss population]. Magglingen: Bundesamt für Sport.

68

Soziale Faktoren des Sport- und Bewegungsverhaltens

Title
Conditions of inclusion for people with disabilities in sport clubs.

Authors/Affiliation
Christoffer Klenk[1], Julia Albrecht[1] & Siegfried Nagel[1]
[1]Institute of Sport Science, University of Bern

Abstract

Introduction

Sport participation provides important bio-psycho-social benefits of physical activity for people with disabilities (PwD). However, PwD are under-represented in sport compared to a non-disabled population (e.g. Ullenhag et al., 2012). This situation is also applicable to organized sport, as membership rates of PwDs in volunteer sport clubs (VSC) are significantly low (Becker & Anneken, 2012). Moreover, club-based disability sport often remains separate, even though VSCs are considered to have a high potential for providing social inclusion (Østerlund & Seippel, 2013). This paper identifies and considers conditions that affect the inclusion of PwDs in VSCs. Research indicates there are various barriers at a systemic level (e.g. Jaarsma et al., 2014). In VSCs, the systemic club-specific conditions of the club structure, culture, and practices are considered to be crucial influence factors (DBS, 2014). The study's objective is to analyze if these conditions promote or hinder sport participation of PwDs in VSCs.

Methods

Using a case study design, a total of 16 VSCs with training groups for PwDs in the German-speaking part of Switzerland were selected. Eight of these groups are for people with and without disabilities (inclusive setting), and eight groups are only for PwDs (separate setting). Data was collected using a triangulation of instruments applied to conditions at a group and club level. The conditions at a club level were analyzed through a standardized online questionnaire for the club's board, used to gather information about the club structure (e.g. service provision, resources, cooperation) and the club culture (e.g. philosophy, attitudes, knowledge). The group-level conditions were analyzed through problem-centered interviews with training group coaches on established practices (e.g. planning and execution of training, social interaction between participants).

Results & Discussion

Analyses focus on the identification of conditions on both group and club level in both settings. Initial findings reveal there are peculiarities specific to disability sport that differ from non-disability sport (e.g. other sports, larger differences in motor skills, closer supervision, respectful social interaction). Moreover, crucial conditions enabling effective inclusion could be identified (e.g. adaption of training programs, availability of resources, open-minded attitudes). The analysis for comparing the conditions in both settings is still in progress, but will be finalized by the congress.

This study provides new insight into the issue of inclusion of PwDs in VSC, in particular, through the comparison of different settings, which have not been explored in Switzerland to date. Based on these findings, practical implications for club management can be derived to eliminate barriers and develop supportive measures that ensure effective inclusion of PwDs in VSCs.

References

Becker, F. & Anneken, V. (2013). Herausforderungen an eine inklusive Sportlandschaft – Ergebnisse einer Befragung von Sportvereinen im Rheinland zu Chancen, Grenzen und Bedarf. In V. Anneken (Hrsg.), *Inklusion durch Sport: Forschung für Menschen mit Behinderungen* (S. 83-104). Köln: Strauß.

Deutscher Behindertensportverband (DBS) (Hrsg.) (2014). *Index für Inklusion im und durch Sport. Ein Wegweiser zur Förderung der Vielfalt im organisierten Sport in Deutschland*. Frechen: Selbstverlag.

Jaarsma, E. A., Dijkstra, P. U., Geertzen J. H. B. & Dekker, R. (2014). Barriers to and facilitators of sports participation for people with physical disabilities: A systematic review. *Scandinavian Journal of Medicine & Science in Sports, 24*, 871–881.

Østerlund, K. & Seippel, Ø. (2013). Does membership in civil society organizations foster social integration? The case of Danish voluntary sport organizations. *Journal of Civil Society, 9*(4), 391-

69

413.

Ullenhag, A., Bult, M.K., Nyquist, A., Ketelaar, M., Jahnsen, R., Krumlinde-Sundholm, L., Almqvist, L. & Granlund, M. (2012). An international comparison of patterns of participation in leisure activities for children with and without disabilities in Sweden, Norway and the Netherlands. *Developmental Neurorehabilitation, 15*(5), 369-385.

Title

Augmented feedback-induced reduction in time on ground can improve running performance

Authors/Affiliation

Rahel Ammann[1,2], Thomas Wyss[1], Severin Trösch[1], Louis Heyer[1,3], Wolfgang Taube[2]
[1]_Swiss Federal Institute of Sport Magglingen, Magglingen, Switzerland; [2]Department of Medicine, Movement and Sport Science, University of Fribourg, Fribourg, Switzerland; [3]Swiss Athletics Federation, Ittigen, Switzerland_

Abstract

Introduction

A shorter ground contact time (GCT) has been associated with faster running time, greater force application during less time, and superior energy-efficiency due to the better use of elastic energy (Bushnell & Hunter, 2007; Paavolainen, Nummela, Rusko, & Hakkinen, 1999; Weyand, Sternlight, Bellizzi, & Wright, 2000). However, GCT in competitive running lasts only about 100-250 milliseconds (depending on speed) for each step (Ammann, Taube, & Wyss, 2016), and therefore, is most likely impossible to judge without the help of an external source. The information about one's own performance provided by an external source is called augmented feedback (aF). The provision of aF has previously been shown to improve motor performance in the short- and long-term (Keller, Lauber, Gehring, Leukel, & Taube, 2014; Lauber, Keller, Leukel, Gollhofer, & Taube, 2013; Moran, Murphy, & Marshall, 2012). Hence, the purpose of the present study was to investigate whether aF about GCT can reduce time on ground per minute in well-trained middle- and long-distance runners and how this transfers to 400 m running performance.

Methods

Thirty well-trained runners (31.0 ±7.5 years old, 1.74 ±0.1 m, 65.2 ±10.2kg, 12 women) of similar level from a regional training group, who undertake regular track training and participate in middle- and long-distance races, were randomly allocated to three groups. Over a 4-week period, the intervention group (IG) and the 1st control group (CG1), undertook identical training with two high-intensity interval sessions per week (e.g., 8 x 600 m with 100 seconds rest or 6 x 1000 m with 150 seconds rest) on a synthetic outdoor track. During the regular rest periods of these interval sessions, the participants in the IG received aF about their GCT visualized on a tablet screen. The averaged GCTs of one interval run were displayed as a bar and an absolute number, next to these information of the previous runs. The aF was provided together with the instruction to minimize GCT in the following run while maintaining running speed. Those in the CG1 had the same training and instructions as the IG, but without aF. The third group, the 2nd control group (CG2), did follow their individual training routine only and did not participate in any training with the IG or CG1. Data for all three groups were obtained at baseline and follow-up. These measurements took place in the laboratory to ensure exactly the same test settings at baseline and follow-up, consisting twice of a 1000 m run at 80% of their maximal 1000 m pace (assessed in a pre-measurement). The blood lactate and the rating of perceived exertion were obtained prior and after and heart rate, step frequency and GCT throughout the treadmill assessments, respectively. The GCT was always measured using a small-sized, light-weight portable inertial measurement unit (Axiamote, Axiamo, Biel, Switzerland), which recently was validated (Ammann et al., 2016). The sensors were tightly attached to the shoe laces of each shoe. The GCT is closely related to step frequency and may not be investigated isolated. Hence, to avoid a bias the dependent variable in this study was time on ground (TOG) per minute, computed of step frequency and GCT. The intervention effects on TOG were evaluated using marginal means model analyses with group$_{(IG, CG1, CG2)}$ and intervention$_{(baseline, follow-up)}$ as main effects and group*intervention as an interaction effect (Fitzmaurice, Laird, & Ware, 2011). _Post hoc_ tests (Bonferroni) were carried out to determine between-group differences. To investigate the effect of changed TOG on running performance, the same statistical analyses were applied. Running performance was defined as the average 400 m times in the IG and CG1 of the 9th and 10th runs from the 10 x 400 m all-out interval training and compared between the first and the 8th training session.

Results

Optimizing performance

A significant interaction effect was observed for group$_{(IG, CG1, CG2)}$*intervention$_{(baseline, follow-up)}$ ($F_{2,27}$ = 4.284, p = .024, η^2_p = .24), but neither a group nor an overall intervention effect occurred. Only the IG could significantly reduce TOG (p = .043, -1.7% with 90%CL -3.1; -0.3) between baseline and follow-up, whereas no favourable changes occurred in the CG1 and CG2 (+1.1% with 90%CL -0.5; +2.6 and +0.8% with 90%CL -0.4; +2.1, respectively; Figure 1a). The IG's step frequency (p = .045, -1.5% with 90%CL -2.7; -0.4) and heart rate (p = .031, -2.6% with 90%CL -4.4; -0.7) were significantly lower during the follow-up than during the baseline measurement. Considering the 400 m performance, a significant intervention$_{(baseline, follow-up)}$ ($F_{1,18}$ = 11.92, p = .003, η^2_p = .40) but no group$_{(IG, CG1)}$ or interaction effect was detected. Within-group analyses revealed that only the IG significantly improved 400 m running performance (p = .012, -2.0% with 90%CL -3.1; -0.9), whereas the CG1 did not show significant changes (-0.9% with 90%CL -1.9; +0.2; Figure 1b).
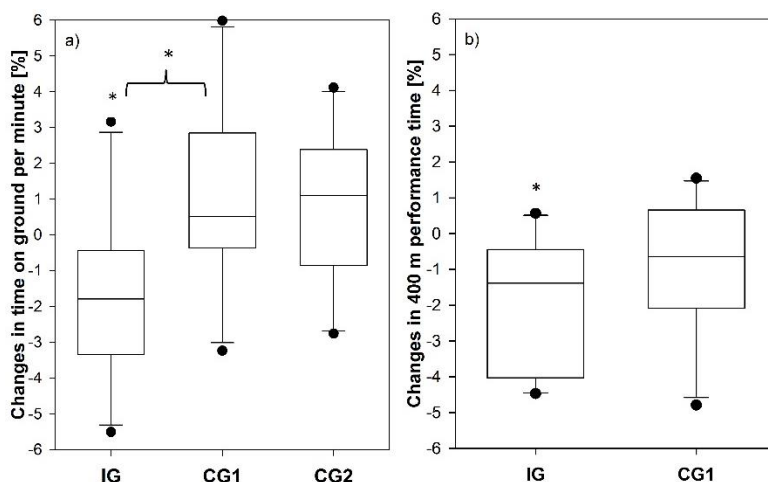

Figure 1. Relative changes in time on ground per minute (a) and relative changes in 400 m performance time (b) between baseline and follow-up measurements. IG = intervention group, CG1 = 1st control group, CG2 = 2nd control group. *p < .05: significant intervention$_{(baseline, follow-up)}$ difference between- and/or within-group.

Discussion/Conclusion

Recently, aF has been shown to evoke better improvements in performance than the same training without feedback (Keller et al., 2014; Moran et al., 2012). The findings of the present study are in line with these observations, showing superior results in the IG that received aF compared to the CG1 and CG2 that did not receive aF. Although the participants in CG1 followed the same training sessions and received the same instructions as the IG, they were not able to reduce TOG. Instead, the CG1 showed similar unchanged TOG values at follow-up as the CG2 that did not attend any training sessions with the IG. The reason for this may be related to the fact that the runners themselves were not able to properly perceive their GCT. A previous study showed that high-level tennis players could not judge whether a tennis serve was faster or slower than the previous serve (Moran et al., 2012). By providing this information in form of aF, players enhanced service speed. Therefore, the aF seems necessary in order to adequately adjust movement execution. However, in previous studies the parameters that were fed back had to be either minimized or maximized, e.g., the service speed in tennis (Moran et al., 2012). It was unclear if aiming for a minimized GCT would be beneficial in well-trained runners as GCT may follow an optimum instead of a minimum function. However, the running speed on treadmill was twice identical, and still, at follow-up the IG with aF showed significantly reduced TOG while at the same time heart rate was significantly reduced and blood lactate and ratings of perceived exertion tended to be lower. Moreover, the 400 m running times were significantly reduced within the IG, but not within the CG1. Although, there was no between-group difference, the finding of 2.0% reduction in the 400 m performance time for the IG compared to the 0.9% reduction in the CG1 might already be a relevant observation in well-trained runners.

Optimizing performance

This intervention study was fully implemented in the existing training routine of well-trained runners and was conducted under free-living conditions. From a functional point of view, the use of this relatively simple measurement technique in the field- and group-setting revealed promising training outcomes. The provision of aF about GCT therefore seems to be a promising approach that should be considered for well-trained runners.

References

Ammann, R., Taube, W., & Wyss, T. (2016). Accuracy of PARTwear Inertial Sensor and Optojump Optical Measurement System for Measuring Ground Contact Time During Running. *J Strength Cond Res, 30*(7), 2057-2063. doi: 10.1519/JSC.0000000000001299

Batterham, A. M., & Hopkins, W. G. (2006). Making meaningful inferences about magnitudes. *Int J Sports Physiol Perform, 1*(1), 50-57.

Bushnell, T., & Hunter, I. (2007). Differences in technique between sprinters and distance runners at equal and maximal speeds. *Sports Biomech, 6*(3), 261-268. doi: 10.1080/14763140701489728

Fitzmaurice, G. M., Laird, N. M., & Ware, J. H. (2011). Contrasting Marginal and Mixed Effects Models *Applied Longitudinal Analysis* (2nd ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Keller, M., Lauber, B., Gehring, D., Leukel, C., & Taube, W. (2014). Jump performance and augmented feedback: immediate benefits and long-term training effects. *Hum Mov Sci, 36*(0), 177-189. doi: 10.1016/j.humov.2014.04.007

Lauber, B., Keller, M., Leukel, C., Gollhofer, A., & Taube, W. (2013). Specific interpretation of augmented feedback changes motor performance and cortical processing. *Exp Brain Res, 227*(1), 31-41. doi: 10.1007/s00221-013-3482-8

Moran, K. A., Murphy, C., & Marshall, B. (2012). The need and benefit of augmented feedback on service speed in tennis. *Med Sci Sports Exerc, 44*(4), 754-760. doi: 10.1249/MSS.0b013e3182376a13

Paavolainen, L., Nummela, A., Rusko, H., & Hakkinen, K. (1999). Neuromuscular characteristics and fatigue during 10 km running. *Int J Sports Med, 20*(8), 516-521. doi: 10.1055/s-1999-8837

Weyand, P. G., Sternlight, D. B., Bellizzi, M. J., & Wright, S. (2000). Faster top running speeds are achieved with greater ground forces not more rapid leg movements. *J Appl Physiol (1985), 89*(5), 1991-1999.

Optimizing performance

Title

Foot-worn inertial sensors assessment of the temporal events and contact time during running.

Authors/Affiliation

Mathieu Falbriard[1], Frédéric Meyer[2], Grégoire Millet[2], Kamiar Aminian [1]

[1]Laboratory of Movement Analysis and Measurement, Swiss Federal Institute of Technology in Lausanne, Lausanne, Switzerland; [2]Institute of Sport Sciences, University of Lausanne, Lausanne, Switzerland.
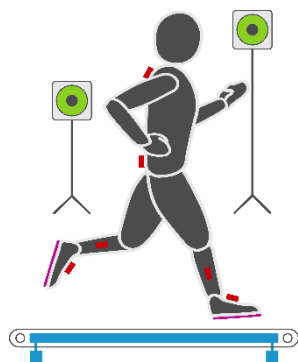
Abstract

Introduction

Contact time is an important parameter in running analysis as a short contact time has been associated with better performances and more energy efficient running [1, 2]. Moreover, contact time is also critical input parameter in the various spring-mass models for running [3]. In the literature, the majority of studies that measured contact time have used a force plate [1,4] and contact mat (e.g. ergojump) as reference measurement system. Although force plates provide state-of-the-art accuracy for stance phase temporal events detection in running, they suffer from several limitations. Their lack of portability and their setup complexity restrict their use for in-laboratory experiments, which is a major drawback given the in-field nature of the running activity. However, recent studies have investigated the potential of Inertial Measurement Units (IMUs) to fill the gap between subjective observational analysis and bulky in-laboratory installations. Although a few running gait parameters have been investigated [5, 6, 7], previous researches in walking gait analysis [8] suggest that there is more to expect from IMUs in running analysis. In addition, none of the previous studies has validated their algorithms with gold standard systems for a large variety of speeds. Because temporal events detection is the first building block of a more detailed running analysis, the goal of this project is to validate running gait temporal events detection algorithms using foot-worn inertial sensors against gold standard systems.

Methods

In this study, we recruited 41 healthy participants without specific criteria on their running background. After removing the trials with measurement errors, 35 participants were left for the design and validation of our algorithms. To avoid overfitting, the algorithms were tested using a randomly selected subset of 10 participants and were then validated over the entire dataset. As testing was carried out on a treadmill, participants were taken through a 6 minutes familiarization session prior to the measurements [9]. A data capture session comprised multiple runs of approximately 40 seconds with a resting period of self-selected duration in-between. Initially the treadmill speed was set at 8 km/h and was later incremented by 2 km/h for each new run. The maximum running speed recorded was set by each participant given their ability to comfortably maintain the treadmill velocity. Participants were equipped with 8 body-worn IMUs (©Physilog GaitUp) measuring 3D acceleration and 3D angular velocity at 500 Hz. Gold standards systems such as a 3D force plate at 1000 Hz, 8 BTS infrared motion cameras at 100 Hz and 2 pressure insoles at 100 Hz were also used to record state of the art reference data. The complete setup is presented on figure 1. IMUs, force plate and BTS motion cameras were synchronized using an analog trigger recorded on each system.

In this study, the force plate was used as reference system for temporal events detection of the running gait. Initial contact (IC) and toe-off (TO) were detected using a threshold on the filtered vertical force signal of each step. Because the detection accuracy depends on the value of the reference threshold, we have tested several threshold in absolute value and in percent of the participant's body weight. We then designed algorithms based on the signals from the foot-worn IMUs to estimate IC and TO and compared our detection results with the force plate. We

Figure 6: Measurement systems used to construct the database. In red the IMUs, in blue the force plate, in green the motion cameras and in violet the pressure insoles.

Optimizing performance

identified 10 kinematic features on the inertial sensors signal and their derivatives, such as peaks, valley, zero-crossings, and inflection points for IC detection which we labelled K_i, with i = 1,2,..,10 and 10 features for TO detection which we labelled T_s, with s=1,2,…,10. We later selected the best 3 candidates for IC and TO based on their detection precision (i.e. standard deviation) results. Finally, we combined theses 6 candidates into 9 pairs (i.e. 3 for IC and 3 for TO) and evaluated their capacity to assess contact time.

Results

We found that the best estimator for contact time has an accuracy (mean) and precision (standard deviation) of -3.7±7ms when averaged over all the 238 runs (i.e. all subjects from 8km/h to 20 km/h) and when the reference threshold on the force plate signal is set to 9% of the subject bodyweight. Similarly, expressed relatively to the force plate reference value, the mean and standard deviation errors is -0.9±3.05%. The range of contact measured vary from 130 ms to 396 ms. Moreover, the two kinematic features used to estimate IC and TO were detected for more than 99.6% of the 18895 steps (i.e. 76 steps were dropped).

Discussion/Conclusion

This study sought to examine the capacity of foot-worn inertial sensors to assess the stance phase temporal events in running. The results show that such system is valid and reliable for contact time estimation with a precision of 3.05% which is below the results of a previous study that found a precision of 6.1% when comparing with high-speed cameras [9]. Moreover, we observed a trend between the system accuracy and the speed of the treadmill. This suggests that we could optimize the accuracy of our algorithm using a corrective model based on the runner's velocity. The large spectrum of running speeds and foot-strikes patterns used in this study suggest that such system has a good potential to be valid when used outside of a laboratory. In addition, detecting accurate temporal events IC and TO also allow to measure flight time, cadence, and eventually stride-to-stride variability. However, one limitation of this validation is that all runs were made on a plane surface, hence we cannot assess the capacity of our algorithms when used on inclined ground surface. The kinematic features used to detect IC and TO were based on both the accelerometer norm and the medio-lateral angular velocity of the foot. The repeatability and robustness of this detection methods also suggest that our automatic anatomical alignment of the foot-worn sensors internal frames is valid for running applications. Finally, the influence of the reference threshold used on the vertical force signal still has to be investigated in more details. Our choice of using the 9% bodyweight reference threshold was based on its robustness to detect stance phase temporal events at low running velocities.

References

[1] Weyand, P. G., Sandell, R. F., Prime, D. N., & Bundle, M. W. (2010). The biological limits to running speed are imposed from the ground up. Journal of applied physiology, 108(4), 950-961.

[2] Santos-Concejero, J., Granados, C., Irazusta, J., Bidaurrazaga-Letona, I., Zabala-Lili, J., Tam, N., & Gil, S. M. (2013). Differences in ground contact time explain the less efficient running economy in North African runners. Biology of sport, 30(3), 181-187.

[3] Morin, J. B., Samozino, P., Zameziati, K., & Belli, A. (2007). Effects of altered stride frequency and contact time on leg-spring behavior in human running. Journal of biomechanics, 40(15), 3341-3348.

[4] Nummela, A., Keränen, T., & Mikkelsson, L. O. (2007). Factors related to top running speed and economy. International journal of sports medicine, 28(08), 655-661.

[4] Strohrmann, C., Harms, H., Tröster, G., Hensler, S., & Müller, R. (2011, September). Out of the lab and into the woods: kinematic analysis in running using wearable sensors. In Proceedings of the 13th international conference on Ubiquitous computing (pp. 119-122). ACM.

[5] Giandolini, M., Poupard, T., Gimenez, P., Horvais, N., Millet, G. Y., Morin, J. B., & Samozino, P. (2014). A simple field method to identify foot strike pattern during running. Journal of biomechanics, 47(7), 1588-1593.

[6] Rahel, A. (2016). Accuracy of PARTwear inertial sensor and Optojump optical measurement system for measuring ground contact time during running. Journal of Strength and Conditioning Research.

Optimizing performance

[7] Mariani, B., Rouhani, H., Crevoisier, X., & Aminian, K. (2013). Quantitative estimation of foot-flat and stance phase of gait using foot-worn inertial sensors. Gait & posture, 37(2), 229-234.

[8] Lavcanska, V., Taylor, N. F., & Schache, A. G. (2005). Familiarization to treadmill running in young unimpaired adults. Human Movement Science, 24(4), 544-557.

Title
Important muscles while elite gymnasts sustain a strength and hold element on the still rings

Authors/Affiliation
Didier Staudenmann[1], Martin Keller[1], Christoph Schaerer[2], Wolfgang Taube [1]
[1]Movement and Sport Science, Department of Medicine, University of Fribourg, 1700 Fribourg, Switzerland; [2]Swiss Federal Institute of Sport, Magglingen, Switzerland

Abstract
Introduction
The planche represents an important strength and hold element on the still rings, but its muscle activity was only investigated in a few studies. For instance differences in muscle activity was analyzed for the swallow, another strength and hold element (Bernasconi, 2009). In this previous study averaged activity was considered, thus it remains unknown how the muscle activity changes over time when sustaining the planche on the still rings. The aim of this study was to determine the dynamic contribution of nine muscles around the shoulder, while elite gymnasts sustained the planche for as long as possible.

Methods
In six elite gymnasts we measured nine muscles surrounding the shoulder with surface electromyography (EMG) organized in four functional groups: 1) Trapezius superior, mid, inferior, serratus anterior, 2) latissimus dorsi, pectoralis major (PM), 3) infraspinatus (IS), teres major, deltoid anterior, mid, posterior (DEa, DEm, DEp), 4) biceps and triceps brachii (BB, TB). From the processed EMG envelopes (cf. Staudenmann, 2007) that were normalized to maximum voluntary contraction (%MVC) we calculated mean, variation and increase (%MVC/s) while sustaining the planche for as long as possible.

Results
The planche was sustained for a duration of 2.4–11.8 s. Overall main active muscles were PM-DEm-BB-IS-DEa (56-68%). The variation in muscle activity was largest for DEa-IS-TRm-PM (11-24%). From the main active muscles the activity of DEm-IS-DEa primarily decreased over time, while for BB and PM it increased over time. As large spread over all subjects was found, data of individual gymnasts are additionally presented, which indicate subject-specific muscle activities.

Discussion/Conclusion
The main active muscles were BB-IS-DEa with highest variation for DEa-IS-PM and the activity of DEa-IS decreased while for BB-PM it increased over time. Thus DEa-IS are the main limiting muscles and BB-PM become important when sustaining the planche for as long as possible. Overall, DEa and BB are expected to importantly contribute to the trunk extension moment in the shoulder, while IS and PM as well as all other muscles, expect LD, importantly contribute to stabilize the biomechanically unstable planche. However, the large overall spread and the outcome of individual gymnasts indicated a subject-specific strategy in muscle activity when sustaining the planche for as long as possible.

References
Bernasconi, SM., et al. (2009). Can shoulder muscle coordination during the support scale at ring height be replicated during training exercises in gymnastics? _J Strength Cond Res_, 23(8), 2381-2388.
Staudenmann, D., et al. (2007). Effects of EMG processing on biomechanical models of muscle joint systems: sensitivity of trunk muscle moments, spinal forces, and stability. _J Biomech_, 40(4), 900-909.

Training and Coaching 1

Title

Influence of artificial light exposures on acoustic reaction time and melatonin levels in male elite endurance athletes – non-primary results of a double-blind randomized controlled trial

Authors/Affiliation

Raphael Knaier[1], Juliane Schäfer[1,2], Anja Rossmeissl[1], Christopher Klenk[1], Henner Hanssen[1], Christian Cajochen[3,4], Arno Schmidt-Trucksäss[1]

[1]Department of Sport, Exercise and Health, University of Basel, Basel, Switzerland; [2]Basel Institute for Clinical Epidemiology and Biostatistics, University Hospital Basel, Basel, Switzerland; [3]Centre for Chronobiology, Psychiatric Hospital of the University of Basel, Basel, Switzerland; [4]Transfaculty Research Platform Molecular and Cognitive Neurosciences, University of Basel, Basel, Switzerland

Abstract

Introduction

Major sports competitions often take place in the late evening when many athletes have exceeded the time of day of their peak performance. Variations in performance over the course of a day are caused by the circadian rhythm of a person. Light exposure can shift the circadian rhythm, lower melatonin levels (Cajochen, 2007), increase alertness and even positively influence cycling performance (Kantermann et al., 2012). In non-athletes, both exposure to blue light and caffeine administration reduces visual and acoustic choice reaction time to a similar extent (Beaven & Ekström, 2013). However, in many competitions simple acoustic reaction time (RT) is more relevant. Studies including athletes are rare and only blue but not bright light has been investigated as a method to improve reaction time. We assessed the influence of evening light exposure on RT and melatonin levels which were pre-specified secondary outcomes in a trial investigating cycling performance as the primary outcome in young male athletes.

Methods

Seventy-four athletes (VO$_2$max ≥55 ml/kg/min) were randomized to three different light exposures: bright light (~4400 lx) = BRIGHT, monochromatic blue light (~230 lx) = BLUE, and a control condition (~230 lx) = CONTROL. Before and after the light exposure a 5-minute computer-based acoustic reaction time test had to be completed and melatonin levels were measured. Light exposure lasted for 60 minutes and started 17 hours after the individual midpoint of sleep. Light intensity reaching the participants´ eyes was measured with a sensor attached to glasses. Analysis of covariance was used to assess the effect of light exposure on RT. Regression analysis was used to examine a potential dose-response relationship between the actual light intensity (lx) and changes in RT.

Results

Two participants had to be excluded retrospectively because it was uncertain if they fulfilled the inclusion criteria of the trial. The remaining 72 participants had a median age of 23 years in BRIGHT (n=24), 22 years in BLUE (n=24) and 24 years in CONTROL (n=24). The adjusted difference in acoustic RT was -1 ms (95% confidence interval [CI] -8, 6) for participants in BRIGHT and 2 ms (95% CI -5, 9) for participants in BLUE, both relative to participants in CONTROL. Actual median light exposure intensities were 1326 lx in BRIGHT, 203 lx in BLUE and 115 lx in CONTROL, respectively. In additional regression analysis, an increase of 100 lx was associated with a change in RT of 0.3 ms (95% CI -0.6, 1.1). After the light exposure 17% of participants in BRIGHT, 22% in BLUE and 29% in CONTROL showed a melatonin concentration of at least 2 pg/ml, representing the dim light melatonin onset.

Discussion/Conclusion

So far, this is the largest study in elite endurance athletes and our results suggest that, in contrast to studies with non-athletes, exposure to either bright or blue light does not improve reaction time at a time of day that is relevant for athletes in sports competitions. There was no evidence for a dose-response relationship between light intensity and changes in reaction time.

References

Beaven, C. M., & Ekström, J. (2013). A Comparison of Blue Light and Caffeine Effects on Cognitive Function and Alertness in Humans. PLoS ONE, 8(10), e76707.

Cajochen, C. (2007). Alerting effects of light. Sleep Medicine Reviews, 11(6), 453–464.

Training and Coaching 1

Kantermann, T., Forstner, S., Halle, M., Schlangen, L., Roenneberg, T., & Schmidt-Trucksäss, A. (2012). The stimulating effect of bright light on physical performance depends on internal time. PLoS ONE, 7(7), e40655.

Training and Coaching 1

Title

Influence of a three weeks exposure to air pollution on lung function of wheelchair racing athletes

Authors/Affiliation

Claudio Perret[1,2], Jörg Leuppi[3], Franz Michel[2] and Matthias Strupler[1,2]

[1]Institute of Sports Medicine and [2]Swiss Paraplegic Centre, Nottwil, Switzerland; [3]Department for Internal Medicine, University Hospital Basel, Switzerland

Abstract

Introduction

Beijing is among the most air polluted megacities in the world. Based on this fact, many experts warned of decreased athletic performance and serious health problems in view of the Olympic and Paralympic Games 2008 (Lippi et al., 2008). Amongst other health problems, difficulties in breathing, respiratory discomfort, airway irritation, asthma like symptoms and a reduced forced expiratory volume in one second (FEV1) were expected to appear during the Olympic and Paralympic Games 2008 due to bad air quality (Florida-James et al., 2004). Due to reduced lung function (Kelly et al., 2003) and restricted pulmonary capacity during physical activity (Silva et al., 1998) wheelchair athletes seem to be even more prone to develop respiratory complications under bad air conditions, which possibly lead to a severe decrease in athletic performance. The aim of the present investigation was to assess possible effects of the expected air pollution on lung function of Swiss wheelchair athletes participating at the Paralympic Games 2008 in Beijing.

Methods

Forced vital capacity (FVC), FEV1 and peak expiratory flow (PEF) were determined during the medical examination at home (pre-test) as well as during the first (post-test 1) and the third week (post-test 2) after the arrival at the Paralympic Village. Concomitantly concentration of particulate matters (PM10) was measured during the whole stay in Beijing.

Results

Post-test lung function measurements where performed 4.1±1.6 days and 16.7±0.5 days after arrival at the Paralympic Village. Analysis of variance revealed no differences concerning pre- and post-test lung function measurements. Average daily concentration of PM10 ranged between 22 and 119 µg/m³. No significant correlations were found between PM10 concentrations and lung function measurements.

Discussion/Conclusion

Although quite high at some days, air pollution was less than suspected in advance of the Paralympic Games 2008 presumably due to restrictive sanctions (reduced traffic, closing down of factories) of the organising committee. The measured PM10 concentrations seemed to have no effect on lung function as none of the athletes showed any respiratory complications or decreased lung function during the stay at the Paralympic Village.

References

Lippi, G., Guidi, G. C., & Maffulli, N. (2008). Air pollution and sports performance in Beijing. *Int J Sports Med, 29*, 696-698.

Florida-James, G., Donaldson, K. & Stone, V. (2004). Athens 2004: the pollution climate and athletic performance. *J Sport Sci*, *22*, 967-980.

Kelly, A., Garshick, E., Gross, E. R., Lieberman, L. S., Tun, C. G. & Brown, R. (2003). Spirometry testing standards in spinal cord injury. *Chest, 123*, 725-730.

Silva, A. C., Neder, J. A., Chiurciu, M. V., Pasqualin, D. C., da Silva, R. C., Fernandez, A. C., Lauro, F. A. & de Mello, M. T. (1998). Effect of aerobic training on ventilatory muscle endurance of spinal cord injured men. *Spinal Cord 36*, 240-245.

80

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Training and Coaching 1

Title

The effect of lower body positive pressure on the cardiorespiratory response to submaximal running exercise.

Authors/Affiliation

Stucky Frédéric, Uva Barbara, Kayser Bengt
Institute of Sport Sciences, Faculty of Biology and Medicine, University of Lausanne

Abstract

Introduction

The Alter-G is an anti-gravity treadmill for the rehabilitation of patients with reduced mobility and/or exercise intolerance. It provides weight support by applying a positive pressure on the lower body (LBPP). Apart from providing body weight support, LBPP may translocate blood from the lower limbs to the trunk. It is unknown if this modifies the cardiorespiratory response to running exercise.

Methods

Nine healthy males (26.1±2.1 yrs, 176.8±4.4 cm, and 66.8±5.5 kg) stood upright and ran at 9, 11, 13 and 15 $km.h^{-1}$ (5 min stages), at 0, 15 and 40 mmHg LBPP. Steady state cardiac output (CO) was estimated from thorax bio-impedance changes and heart rate; oxygen uptake (VO_2) was monitored breath-by-breath using a respiratory gas analyzer. Blood pressure was monitored beat-by-beat with finger plethysmography; peripheral resistance (PR) was calculated from MAP and CO. Potential effects of pressure on the lower abdomen on functional residual capacity (FRC) were monitored with inspiratory capacity (IC) maneuvers.

Results

At rest, after 3 minutes of LBPP, CO (5.1±0.9 vs 5.3±1.0 vs 5.3±1.1 $l.min^{-1}$ at 0, 15 and 40 mmHg LBPP (P=NS)), and VO_2 (256.0±24.7 vs 256.4±35.6 vs 252.1±27.2 $ml.min^{-1}$ (P=NS)) were unchanged. While the increase of speed was accompanied by an increase in VO_2 in all conditions, increasing LBPP led to significant decreases in VO_2 and in CO at all speeds, at 15 $km.h^{-1}$ amounting to 2346±439 vs 2007±335 vs 1320±348 $ml.min^{-1}$ for VO_2, at 0, 15 and 40 mmHg, respectively (P<0.05) and 21.7±1.8 vs 19.4±1.5 vs 14.3±2.2 $l.min^{-1}$, respectively for CO (p<0.05). Mean arterial blood pressure (MAP) remained unchanged (99.6±0.3 vs 94.0±6.0 vs 100.5±1.5 mmHg, respectively (P=NS)). Regardless the level of pressure, CO vs VO_2 and PR vs VO_2 relationships remained linear and with similar slope for each subject with a mean r^2 of 0.88±0.07 and 0.84±0.09, respectively. For a given level of ventilation IC values remained constant, suggesting invariant thoraco-abdominal breathing configurations in all conditions.

Discussion/Conclusion

Our findings suggest that (1) LBPP reduces the cardiorespiratory load proportionally to the reduced metabolic demand resulting from the body weight support; (2) At steady-state, potential transitory effects of the application of LBPP on cardiovascular parameters are abolished, suggesting that the cardiovascular response and oxygen delivery to the exercising muscle remain balanced and that cardiac afterload is unaffected. These findings suggest potential for the use of LBPP-type treadmills for patients with cardiorespiratory disease, but this remains to be investigated.

References

Nishiyasu, T., S. Hayashida, A. Kitano, K. Nagashima and M. Ichinose (2007). "Effects of posture on peripheral vascular responses to lower body positive pressure." Am J Physiol Heart Circ Physiol **293**(1): H670-676.

Nishiyasu, T., K. Nagashima, E. R. Nadel and G. W. Mack (1998). "Effects of posture on cardiovascular responses to lower body positive pressure at rest and during dynamic exercise." J Appl Physiol (1985) **85**(1): 160-167.

Shi, X., C. G. Crandall and P. B. Raven (1993). "Hemodynamic responses to graded lower body positive pressure." Am J Physiol **265**(1 Pt 2): H69-73.

Motor Inhibition

Title

Surround inhibition in the motor system is selectively modulated by different attentional foci

Authors/Affiliation

Yves-Alain Kuhn[1], Martin Keller[1], Benedikt Lauber[2], & Wolfgang Taube[1]
[1]Movement and Sport Sciences, Department of Medicine, University of Fribourg, Switzerland
[2] Department of Sport Science, University of Freiburg, Freiburg, Germany

Abstract

Introduction

Although it is well established that an external focus (EF) contrasted to an internal (IF) or neutral focus of attention enhances motor performance and learning, the underlying neural mechanisms remain poorly understood. What has been constantly reported is the observation that an EF results in reduced muscular activity in both the agonist (Wulf, Dufek, Lozano, & Pettigrew, 2010) and the antagonist (Lohse, Sherwood, & Healy, 2011). Based on this, it was speculated that an EF increases movement efficiency and inhibits unnecessary muscular activity. In line with this assumption, we have shown that focusing externally results in a differential cortical processing compared to an IF (Kuhn, Keller, Ruffieux, & Taube, 2016). More specifically, changing the focus of attention instantly modulates the activity of inhibitory circuits within the primary motor cortex (M1). Consequently, we speculated that this enhanced intracortical inhibition during EF might be one of the underlying neural mechanisms why motor performance is generally more efficient with an EF, as the motor command seems to be more focused. However, it has to be noted that these findings exclusively relate to the agonistic muscle and cannot be extended to the surrounding muscles. Therefore, the current study focused on another inhibitory parameter, which is called surround inhibition (SI). SI is a neural mechanism within the primary motor cortex that focuses neural activity and facilitates selective motor execution (Beck & Hallett, 2011). SI can be measured by applying suprathreshold single-pulse TMS over the contralateral M1. The magnetic stimulus evokes not only motor evoked potentials (MEPs) in the agonistic muscle by activating the responsible neurons in M1 but activates also surrounding cortical neurons that are responsible to control adjacent muscles that are not necessarily needed or might even be counterproductive for the desired movement execution. In contrast to patients with focal hand dystonia, for example, healthy people are able to suppress this activity in the adjacent muscles by increasing SI at the beginning of the movement (Beck et al., 2008) indicated by reduced MEPs in these adjacent muscles. In other words, SI enables the selective execution of desired movements in humans by inhibiting the activity of surrounding cortical cells. The aim of the present study was therefore to evaluate the influence of different attentional foci (EF vs. IF) on SI. We hypothesized that EF results in an enhanced SI.

Methods

In experiment 1, 14 subjects (22-35 y, 3 women) performed 5 maximal contractions with the tip of their index finger in response to an acoustic signal. The motor task, inducing a contraction of the first dorsal interosseous muscle (FDI), was repeated twice under both focus conditions (EF and IF). Experiment 1 aimed to a) verify that our task is able to detect behavioural differences between EF and IF and b) to investigate electromyographic (EMG) activity of the involved muscles (FDI, APB and ADM).

In Experiment 2, subjects were instructed to produce 10% of their maximum force by pressing with the tip of their index finger on a force transducer right after the appearance of a tone. Thereafter, they should hold the contraction at the target force level for 2 s. The force level was individually adjusted and displayed as a line on an oscilloscope in front of them. The output of the force transducer was also displayed on the oscilloscope as visual feedback. Ten percent of Fmax were chosen based on previous research (Beck, Schubert, Richardson, & Hallett, 2009) showing that identification of SI is easier at low-force levels. TMS at 140% of motor threshold was applied over M1 and MEPs were recorded from the prime mover FDI and the surrounding muscles APB and ADM. TMS was applied randomly at four different phases of the ramp and hold contraction: control (500 ms after the first acoustic signal), premotor (between 100 and 200 ms after the second tone), phasic (between 300 and 600 ms after the second tone), and tonic phase (2700 ms after the second tone). The different time points of stimulation for the premotor and phasic phases were adjusted individually after several practice trials. Experiment

82

Motor Inhibition

2 aimed to outline differences in SI between both focus of attention conditions (EF vs IF) during the premotor phase, as this phase was previously shown to be highly sensitive for SI (Beck & Hallett, 2011).

Results

In experiment 1, participants generated more absolute force (+14.71%, t_{13} = 5.46, $p < 0.001$) and more force on average in the FDI (+10.58%, t_{13} = 3.77, $p = 0.002$) when adopting an EF contrasted to an IF. Additionally, less EMG activity (-22.37%, t_{13} = - 2.48, $p = 0.02$) was seen in the adjacent APB during EF.

In experiment 2, the pattern of MEP modulation in APB muscle (main effect of phase, $F_{1.92, 21.12}$ = 9.30, $p = 0.001$, $\eta^2 = 0.086$), which indicates the level of SI, showed a clear inhibition before the initiation of the FDI-finger flexion (premotor phase, $p < 0.001$) compared to the control phase and revealed an enhancement of MEPs in the tonic phase contrasted to all other phases (control, $p < 0.001$; premotor, $p < 0.001$; phasic, $p = 0.003$). Most importantly, there was an interaction effect of focus x phase ($F_{3, 33}$ = 7.18, $p < 0.001$, $\eta^2 = 0.005$) and *post hoc* tests revealed a significant decrease of APB MEP amplitudes in the EF compared to the IF condition in the premotor phase (-27.6%, $p = 0.02$). In the ADM muscle, there was no significant MEP modulation between phases ($p = 0.72$) and no significant interaction in MEP modulation between focus and phase ($p = 0.46$). Regarding the background EMG 50 ms prior TMS in the APB and ADM muscles, there was no significant main effect of focus ($p = 0.15$ and $p = 0.91$, respectively APB and ADM), phase ($p = 0.39$ and $p = 0.42$), and interaction effect of focus x phase ($p = 0.58$ and $p = 0.27$).

Discussion/Conclusion

In line with previous research, the first experiment of our study adds to the body of evidence demonstrating beneficial effects on maximal force production (Marchant, 2011) and showing less EMG activity in the antagonist muscle (Lohse & Sherwood, 2011) when receiving externally compared to internally focused instructions.

Most importantly, these behavioral effects were accompanied by a difference in the magnitude of SI in the APB, manifesting itself in reduced MEPs in the premotor phase, when adopting an EF contrasted to an IF (experiment 2). In a previous study (Kuhn et al., 2016), it has been shown that the activity of inhibitory intracortical circuits within M1 was enhanced when adopting an EF compared to an IF. The level and the ability to modulate intracortical inhibition has been shown to influence motor function, such as interlimb coordination (Fujiyama, Hinder, Schmidt, Garry, & Summers, 2012) or dexterity (Heise et al., 2013). Thus, inhibitory processes seem to be closely related to the quality of motor execution in general. As short-interval intracortical inhibition (SICI) has been reported to contribute to SI in healthy subjects (Stinear & Byblow, 2004), our current results extend and complement the findings of our previous study (Kuhn et al., 2016). In this previous study, the focus was laid on the prime mover (FDI). In contrast, the current experiment concentrated on surrounding muscles, showing for the first time that adopting an EF has an impact on the surrounding cortical neurons that are responsible to control and inhibit adjacent muscles. Thus, SI most likely fosters the selective execution of desired movements and preserves motor precision by counteracting widespread corticospinal excitability. Thus, the enhanced SI during EF is argued to enhance movement efficiency by inhibiting unnecessary, counterproductive neuromuscular activity in adjacent muscles.

A typical clinical feature of a disturbed SI can be found in focal hand dystonia patients. The reduced SI in these patients leads to abnormal movements during movement initiation and then results in long-lasting, tonic contraction of antagonistic and other nearby muscles. Thus, in a clinical context, our findings might help therapists to use instructions with an EF when evaluating and treating movement disorders with focal hand dystonia patients. In the applied sports context, our findings help to understand the underlying neural mechanisms that are responsible for the beneficial outcome when movements are executed with an EF.

References

Beck, S., & Hallett, M. (2011). Surround inhibition in the motor system. *Exp Brain Res, 210*(2), 165-172. doi:10.1007/s00221-011-2610-6

Beck, S., Richardson, S. P., Shamim, E. A., Dang, N., Schubert, M., & Hallett, M. (2008). Short intracortical and surround inhibition are selectively reduced during movement initiation in focal hand dystonia. *J Neurosci, 28*(41), 10363-10369. doi:10.1523/jneurosci.3564-08.2008

Beck, S., Schubert, M., Richardson, S. P., & Hallett, M. (2009). Surround inhibition depends on the force exerted and is abnormal in focal hand dystonia. *J Appl Physiol, 107*(5), 1513-1518. doi:10.1152/japplphysiol.91580.2008

Motor Inhibition

Fujiyama, H., Hinder, M. R., Schmidt, M. W., Garry, M. I., & Summers, J. J. (2012). Age-related differences in corticospinal excitability and inhibition during coordination of upper and lower limbs. *Neurobiol Aging, 33*(7), 1484.e1481-1414. doi:10.1016/j.neurobiolaging.2011.12.019

Heise, K.-F., Zimerman, M., Hoppe, J., Gerloff, C., Wegscheider, K., & Hummel, F.-C. (2013). The Aging Motor System as a Model for Plastic Changes of GABA-Mediated Intracortical Inhibition and Their Behavioral Relevance. *J Neurosci, 33*(21), 9039-9049. doi:10.1523/jneurosci.4094-12.2013

Kuhn, Y. A., Keller, M., Ruffieux, J., & Taube, W. (2016). Adopting an external focus of attention alters intracortical inhibition within the primary motor cortex. *Acta Physiol (Oxf)*, n/a-n/a. doi:10.1111/apha.12807

Lohse, K. R., & Sherwood, D. E. (2011). Defining the focus of attention: effects of attention on perceived exertion and fatigue. *Frontiers in Psychology, 2*, 332. doi:10.3389/fpsyg.2011.00332

Lohse, K. R., Sherwood, D. E., & Healy, A. F. (2011). Neuromuscular Effects of Shifting the Focus of Attention in a Simple Force Production Task. *J Mot Behav, 43*(2), 173-184. doi:10.1080/00222895.2011.555436

Marchant, D. C. (2011). Attentional Focusing Instructions and Force Production. *Frontiers in Psychology, 1*, 1-9. doi:10.3389/fpsyg.2010.00210

Stinear, C. M., & Byblow, W. D. (2004). Impaired modulation of intracortical inhibition in focal hand dystonia. *Cereb Cortex, 14*(5), 555-561. doi:10.1093/cercor/bhh017

Wulf, G., Dufek, J. S., Lozano, L., & Pettigrew, C. (2010). Increased jump height and reduced EMG activity with an external focus. *Human Movement Science, 29*(3), 440-448. doi:10.1016/j.humov.2009.11.008

Title

Reward reduces motor slowing observed during maximal finger tapping

Authors/Affiliation

Rea Lehner[1], Marc Bächinger[1], Joshua Henk Balsters[1], Céline Ghidoni[1], Nicole Wenderoth[1]
[1]Neural Control of Movement Lab, Department of Health and Technology, Zurich, Switzerland;

Abstract

Introduction

Performance on a continuous motor task, such as maximal skipping or sprinting decreases after a certain amount of time. Previous studies showed that finger tapping of a predefined sequence at submaximal and maximal speed, significantly decreases after approximately 20 s of sustained effort (Bächinger et al.; Rickard, Cai, Rieth, Jones, & Ard, 2008). Whilst the underlying mechanism for this phenomenon called motor slowing is unclear, studies from our lab using peripheral nerve stimulation (i.e. M-wave, peak-twitch-force) have shown that this decrease in performance cannot be explained by changes at the neuromuscular junction or distal to the neuromuscular junction (Bächinger et al.). We therefore believe that motor slowing can be linked to central mechanisms. There is strong evidence to suggest that increasing reward can motivate individuals to spend extra physical effort and thus, invigorate certain movements (Bonnelle et al., 2015; Manohar et al., 2015; Pessiglione et al., 2008). The objective of the present study is to investigate whether reward reduces motor slowing and whether neurophysiological markers can be linked to the observed behavioural changes using a non-invasive neuroimaging technique electroencephalography (EEG).

Methods

We tested thirty-four healthy participants (mean age = 27 ± s.d. 7 years, 77% female, all right-handed) using a behavioural paradigm to measure motor slowing combined with EEG (256 channels) to link behavioural performance to central neurophysiological markers during recovery. Furthermore, we applied electromyography (EMG, surface disc electrodes, first dorsal interosseous, extensor digitorium) as a control measurement on the muscles involved in finger tapping.

The experiment included three distinct finger tapping conditions (10 trials per condition): i) *short tapping* (10 s), ii) *long tapping reward* (40s) with the possibility to win a reward (one Swiss Franc coin appeared on the screen after 20 s of tapping) and iii) *long tapping neutral* (40 s) with no possibility to win a reward (neutral grey circle appeared on the screen after 20 s of tapping). Participants were instructed to tap as fast as possible with their dominant index and middle finger when indicated on the screen (go!) and to relax during breaks (fixation cross for 30 s). They were also instructed that they would only receive one Swiss Franc if their performance during a reward trial was better than during the last reward trial (i.e. mean over the whole trial). No feedback about their performance was provided during the experiment. At the end of the experiment, participants received the collected rewards additional to their basic payment (20.- per hour).

Results

We calculated the inter-tapping interval for each 10 s bin averaged across all trials from each condition. The statistical analysis of the inter-tapping interval between the *long tapping reward* and the *long tapping neutral* condition for each time point (4 bins of 10 s) shows a significant main effect of condition (i.e. reward faster than non-reward), significant main effect of time (i.e. tapping speed increased over time), and significant interaction effect (mixed-effects model, $p < 0.001$). The interaction effect shows that the tapping speed is similar for the two conditions until the reward appears (20 s), which then reduces motor slowing. This reveals that motor slowing is present for both long tapping conditions and that it can be reduced by reward.

Four participants were excluded from the EEG analysis because of noisy EEG (2) or EMG (2) data. After a standard pre-processing procedure EEG data was filtered (bandpass, 8-12 Hz) to investigate the alpha amplitude over time (4 bins of 10 s) during recovery. The statistical analysis (mixed-effects model) revealed a significant main effect of time ($p < 0.001$) and condition ($p < 0.001$) over primary motor cortex. Alpha amplitude increased over time showing the highest level for *short tapping* (1.004 µV ± 1.121, m. ± s.e.), a medium level for *long tapping neutral* (0.990 µV ± 1.121, m. ± s.e.) and the lowest level for *long tapping reward* (0.946 µV ± 1.121, m. ± s.e.). A control analysis examining the absolute

Motor Inhibition

and root-mean-square of the EMG for both muscles during tapping, shows no difference between conditions (mixed-effects model, p > 0.143).

Discussion/Conclusion

Our results demonstrated that motor slowing can be remarkably reduced by reward. This further supports our hypotheses that motor slowing could be explained by an underlying central nervous mechanism instead of muscular fatigue. It has been shown that the primary motor cortex is disinhibited after prolonged finger tapping using a transcranial magnetic stimulation protocol (i.e. shot latency intracortical inhibition) (Bächinger et al.). Thus, the decreased alpha activity observed in the *long tapping reward* condition is very likely to result in an increased disinhibition of the primary motor cortex, which then attenuates motor slowing. Recent theories from neuroscience consider dopamine to be the key mediator of the motivational effects of reward that possibly also holds true for the observed reduction of motor slowing in prolonged maximal finger tapping. The exact mechanism remains unknown. A more sophisticated EEG analysis as well as an experiment using functional magnetic resonance imaging to investigate the spatial origin of motor slowing and its modulation by reward is planned. We also intend to conduct several control experiments (i.e. to measure peak-twitch-force, polysynaptic reflexes and H-reflex) to rule out peripheral fatigue.

References

Bächinger, M., Lehner, R., Balsters, J. H., Thomas, F., Bosshard, A., & Wenderoth, N. Contributions of peripheral versus central mechanisms to motor slowing.

Bonnelle, V., Veromann, K. R., Burnett Heyes, S., Lo Sterzo, E., Manohar, S., & Husain, M. (2015). Characterization of reward and effort mechanisms in apathy. J Physiol Paris, 109(1-3), 16-26. doi:10.1016/j.jphysparis.2014.04.002

Manohar, S. G., Chong, T. T., Apps, M. A., Batla, A., Stamelou, M., Jarman, P. R., . . . Husain, M. (2015). Reward Pays the Cost of Noise Reduction in Motor and Cognitive Control. Curr Biol, 25(13), 1707-1716. doi:10.1016/j.cub.2015.05.038

Pessiglione, M., Petrovic, P., Daunizeau, J., Palminteri, S., Dolan, R. J., & Frith, C. D. (2008). Subliminal instrumental conditioning demonstrated in the human brain. Neuron, 59(4), 561-567. doi:10.1016/j.neuron.2008.07.005

Rickard, T. C., Cai, D. J., Rieth, C. A., Jones, J., & Ard, M. C. (2008). Sleep does not enhance motor sequence learning. J Exp Psychol Learn Mem Cogn, 34(4), 834-842. doi:10.1037/0278-7393.34.4.834

Motor Inhibition

Title

How does complex versus simple Go/NoGo training improve motor inhibitory control? An electroimagning study.

Authors/Affiliation

Marie Simonet[1], Jérôme Barral[1]
[1]Institute of Sport Science, University of Lausanne, Lausanne, Switzerland

Abstract

Introduction

Inhibitory control (IC), a key aspect of executive functions, refers to the ability to suppress cognitive or motor processes. Although several experimental studies have reported increased capacity to inhibit motor responses after short-term training, whether the complexity of training influences the behavioural performance and the cortical changes remains poorly understood. So far, it has been reported that IC can be improved if the top-down control mechanisms are constantly solicited during the training session (i.e. by varying stimulus-response mapping and/or increasing the difficulty of the task; see Spierer et al. 2013 for review). Accordingly, one could hypothesize that the practice of complex tasks involving an IC component would modify fundamental IC performance and the underlying brain networks.

Methods

Using electrical neuroimaging methods, we investigated the effects of 50 minutes IC training in two groups of young adults by comparing the effects of simple (n=12) versus complex (n=12) Go/NoGo training. The complexity was manipulated by mixing IC component with additional cognitive loads. At the behavioural level, the reaction time (RT) of the Go trials and the percentage of false alarms for the NoGo trials were compared between the beginning and the end of the 50 min IC training. The electro-cortical changes were evaluated by analysing the event-related potentials (ERPs) assessed at the onset of the NoGo stimuli with a data-driven statistical analyses of global spatial measures (Global Map Dissimilarity, GMD) and strength (Global Field Power, GFP) of the scalp electric field. Electrical source estimations were used to localize the GFP/GMD ERP differences within the brain.

Results

In the complex group but not in the simple one, the RTs significantly decrease while the false alarms remain stable. The GFP analyses revealed a significant difference (p<0.05) between the beginning and the end of the training session for the complex and the simple groups respectively at 270-300 and 320-420 ms post-stimulus onset. Difference in the electrical source estimation revealed significant changes over these two time periods within the frontal and parieto-occipital lobes.

Discussion/Conclusion

Our preliminary results are in line with previous findings and show that implementing additional cognitive loads in a Go/NoGo training task leads to significant IC improvement associated with brain changes after less than one hour of practice (Hartmann et al. 2015). Interestingly, despite no change in IC performance in a simpler condition of Go/NoGo learning, a short-term training effect on brain activation is also observed but later in the processing of stopping. The significance of the training effects observed in this work for perceptual, decisional and inhibition processes will be the core issue of this short communication.

References

Spierer, L., Chavan, C.L. & Manuel, A.L. (2013). Training-Induced Behavioral and Brain Plasticity in Inhibitory Control. *Frontiers in Human Neuroscience* 7: 427. doi:10.3389/fnhum.2013.00427.

Hartmann, L., Sallard, E. & Spierer, L. (2015). Enhancing frontal top-down inhibitory control with Go/NoGo training. *Brain Structure and Function,* 1-8. doi: 10.007/s00429-015-1131-7

Title
Exercise and Healthy Ageing

Scope: The invited session aims at giving an overview on the role of exercise in healthy ageing. The speakers are renowned experts in their field. The three complementary subjects combine applied and molecular approaches in the field of sports science and preventive medicine.

Exercise and neuromuscular ageing (Lars Donath): One out of three seniors above 65 years of age falls once a year. Balance training attenuates declines of neuromuscular capacity and reduces fall rates by 21%. Also fall risk factors (e.g., static, reactive, dynamic and functional balance) benefit in a dose-response relationship from balance training. On the other hand, recent training studies and meta-analyses emphasized that adaptations to balance training seem to be highly task-specific. Transfer effects to non-trained neuromuscular tasks are limited. Thus, the present talk draws a bow from mechanistic considerations of neuromuscular adaptations to neuromuscular training over traditional and non-traditional fall-preventive exercise training programs to evidence-based best-practice recommendations. This lecture underlines the importance of the "task-specificity principle" of balance training adaptations during exercise-based fall prevention. Second, several appealing exercise training approaches on fall risk factors will be discussed in the light of potential "agility" performance in older people. We will further elaborate how these aspects track into general exercise-based fall prevention recommendations. The talk might be relevant for a broad audience interested in recent findings on mechanistic considerations of balance training adaptations and exercise-based and health-related fall prevention recommendations in older people from a practitioners' and researchers' perspective.

Exercise and vascular ageing (Henner Hanssen): Cardiovascular disease is a main determinant of morbidity and mortality in western countries and age is a key risk factor for its development. Older age coincides with a high prevalence of obesity and low levels of physical activity. Ageing is associated with complex structural and functional alterations of the macro- and microvascular bed, but the vascular mechanisms of ageing and its associations with physical activity are unknown. An impairment of the buffer capacity of large arteries and the progression of arterial stiffness may lead to elevated left ventricular afterload and left ventricular hypertrophy and, at later stages, heart failure, increased risk of stroke and dementia due to damaging of the microcirculation.
Retinal vessel analysis (RVA) is a non-invasive technique that allows the examination of the cerebrovascular bed, which is affected early in the process of arteriosclerosis. In recent years we have developed and applied vascular biomarkers such as RVA to help define vascular end organ damage more specifically. The presentation gives insights into the association of large and small artery function with physical fitness and activity in young children as well as older adults. We aim to demonstrate the importance of specific physical activity programmes to achieve healthier ageing as a long-term goal. Exercise-related improvement of vascular function represents the potential to counteract vascular ageing during lifespan.

Regulation of muscle (Katrien de Bock): Skeletal muscle is essential to life as it provides the mechanical power for movement. Therefore, muscle mass is tightly controlled, but the molecular processes through which this occurs are poorly understood. Studying these mechanisms will offer novel insights to develop therapeutic strategies against aged related muscle atrophy (sarcopenia), but also cancer cachexia and many others.
The mammalian target of rapamycin complex 1 (mTORC1) plays a central role in the regulation of muscle mass. It is activated by contractions and growth factors, but also by the availability of amino acids (AA). How these AA are sensed has been subject to intense research, but the relative importance of AA sensing mechanisms in different tissues and the molecular mechanisms thereof still need to be investigated in vivo. It is clear though that, besides AA, mTORC1 dependent protein synthesis requires optimal oxygen availability and it is therefore tempting to speculate that those signals converge at a common sensing mechanism. AA but also other nutrients are delivered to the muscle via the vasculature, which consists of a layer of tightly aligned endothelial cells (ECs). The exact role of ECs in control of nutrient delivery or transport into the muscle is poorly characterized. This is rather surprising, as the EC lining in the muscle is not highly fenestrated and therefore should not allow unlimited paracellular nutrient passage. In fact, very little is known on how the muscle and

88

Sport and Health – prevention

the vasculature communicate to control optimal nutrient delivery, and whether this communication is altered during aging. We therefore aim to study the interaction between the myofiber and its microenvironment to increase our understanding on how muscle mass and metabolism are controlled.

Sport and Health – prevention

Title

Effect of E-Bike vs. Bike Commuting on Cardiorespiratory Fitness in Overweight Adults: A Four-Week Randomized Pilot Study.

Authors/Affiliation

Christoph Höchsmann[1]*, Steffen Meister[1]*, Damiana Gehrig[1], Elisa Gordon[2], Yanlei Li[3], Monique Nussbaumer[1], Anja Rossmeissl[1], Juliane Schäfer[1, 4], Henner Hanssen[1], Arno Schmidt-Trucksäss[1]

[1]Division of Sports and Exercise Medicine, Department of Sport, Exercise and Health, University of Basel, Basel, Switzerland

[2]Center for Healthcare Studies, Feinberg School of Medicine, Northwestern University, Chicago, IL, United States

[3]Center of Medical Physics and Technology, Hefei Institutes of Physical Science, Chinese Academy of Sciences, Hefei, China

[4]Basel Institute for Clinical Epidemiology and Biostatistics, University Hospital Basel, Basel, Switzerland

*These authors contributed equally to this work.

Abstract

Introduction

Electrically assisted bicycles (e-bikes) have gained more and more popularity over the past years. Especially for individuals with low regular physical activity and a low cardiorespiratory fitness, such as the elderly or overweight individuals (Brown & Flood, 2013; Gebel, Bauman, & Owen, 2009), the motor-induced lower perceived exertion while riding makes e-bikes an attractive alternative to conventional bicycles and a promising way to promote regular physical activity (Sperlich, Zinner, Hébert-Losier, Born, & Holmberg, 2012). The objective of this study was to assess if active commuting with an e-bike during a 4-week period can induce increases in cardiorespiratory fitness in untrained, overweight individuals, and if these changes are comparable to those induced by a conventional bicycle.

Methods

In this 4-week randomized pilot study, eligible participants were randomly allocated to either the e-bike group (E-Bike) or the conventional bicycle group (Bike). Cardiorespiratory fitness (as VO_{2peak}) was assessed before and after the intervention. We used analysis of covariance to compare participants in the E-Bike group with those in the Bike group with respect to VO_{2peak} and a number of other health outcomes.

Results

Of 32 eligible participants (28 male), 17 were randomized to the E-Bike group and 15 to the Bike group. VO_{2peak} increased by an average of 3.6 ml/min/kg (standard deviation (SD) 3.6 ml/min/kg) in the E-Bike group and by 2.2 ml/min/kg (SD 3.5 ml/min/kg) in the Bike group, with an adjusted difference between the two groups of 1.4 ml/min/kg (95% confidence interval (CI) -1.4, 4.1; P=0.327). Total distance (km) covered in active commuting was comparable between the two groups. The difference in daily elevation gain between the two groups was 135.6 m (95% CI -43.6, 314.9; P=0.132) in favor of the E-Bike group, suggesting a trend towards a higher elevation gain in the E-Bike group.

Discussion/Conclusion

E-bikes may have the potential to improve cardiorespiratory fitness similar to conventional bicycles. The available power assist makes for a lower perceived exertion while riding and even seems to enable greater elevation gain and higher biking speeds than conventional bicycles thus making e-bikes a suitable exercise tool for physically inactive individuals with a compromised fitness.

References

Brown, C. J., & Flood, K. L. (2013). Mobility limitation in the older patient: a clinical review. *JAMA*, *310*(11), 1168–1177. https://doi.org/10.1001/jama.2013.276566

Gebel, K., Bauman, A., & Owen, N. (2009). Correlates of non-concordance between perceived and objective measures of walkability. *Annals of Behavioral Medicine: A Publication of the Society of Behavioral Medicine*, *37*(2), 228–238. https://doi.org/10.1007/s12160-009-9098-3

Sport and Health – prevention

Sperlich, B., Zinner, C., Hébert-Losier, K., Born, D.-P., & Holmberg, H.-C. (2012). Biomechanical, cardiorespiratory, metabolic and perceived responses to electrically assisted cycling. *European Journal of Applied Physiology*, *112*(12), 4015–4025.

Sport and Health – prevention

Title

Agility testing for fall prevention in seniors: Validity of a novel test course

Authors/Affiliation

Eric Lichtenstein[1], Aline Zubler[1], Oliver Faude[1], Timo Hinrichs[1], Lars Donath[1]
[1]Department for Sport, Exercise and Health, University of Basel, Basel, Switzerland

Abstract

Introduction

Fall prevention requires a successful combination between perception, cognitive function, neuromuscular performance and cardiovascular capacity. These aspects have been mainly tackled separately within exercise-based fall prevention studies (Donath, van Dieën & Faude, 2016). Functional and integrative training approaches are scarce. Thus, the present validity study examined an "**a**gility **c**hallenge for the **e**lderly" (ACE) course compared to traditional fall risk parameters for future testing and training purposes.

Methods

Healthy seniors without clinical conditions (69.0 ± 2.8 y; 25.4 ± 3.5 kg/m^2; 19 m/17 f; 4.7 ± 3.8 h PA/week) were repeatedly tested on two separate days one week apart. All participants completed four trials of the novel ACE-course following a standardized warm-up procedure. A 6-minute walk test was also performed to assess cardiovascular capacity. Traditional lab-based assessment of fall risk parameters was conducted on a separate day and included static, dynamic and perturbed standing balance tasks, rate of force development of the lower extremities and trunk as well as spatio-temporal gait analysis under various conditions. The ACE-course consists of three sections focusing on different agility aspects (1. stop-and-go; 2. cutting maneuvers; 3. spatial orientation). Stepwise linear regression analyses were computed in order to assess the amount of variance of the ACE-test (serving as dependent variable) explained by the lab-based fall risk parameters (serving as predictive factors).

Results

Men completed the course in 43.6 ± 5.9 s and women in 52.4 ± 3.9 s. Apart from sex, the overall course time was mostly explained by 6-minute walking test time (R^2=0.24; p=0.00), followed by gait speed during gait analysis (R^2=0.23; p=0.00) and y-balance composite score (R^2=0.04; p=0.12). Separately analysed split time was also mostly explained be the first two variables. Static balance likely influenced the time in the stop-and-go section (R^2=0.04; p=0.12) that took the participants 6.9 ± 1.0 s. Trunk rotational (R^2=0.05; p=0.08) and plantar flexion (R^2=0.04; p=0.11) explosive strength as well as dynamic balance (R^2=0.04; p=0.11) likely influenced the time in the cutting maneuvers section which was completed in 14.0 ± 2.3 s. Time in the spatial orientation segment was likely influenced by dynamic balance (R^2=0.04; p=0.15) and its duration was 26.8 ± 3.6 s.

Discussion/Conclusion

The agility challenge for the elderly successfully integrates cardiorespiratory, neuromuscular performance and balance. Whether cognitive function affects agility needs to be elucidated further. Future testing and training approaches should tackle integrative motor performance in the elderly. This aspect is particularly important since neuromuscular adaptions are considered highly task specific and transfer effects to not trained tasks are limited (Kümmel, Kramer, Giboin & Gruber, 2016). Thus, function and integrative training and testing approaches might better reflect motor requirement during situations involving high fall risk.

References

Donath, L., van Dieën, J., & Faude, O. (2016). Exercise-based fall prevention in the elderly: what about agility? *Sports Medicine, 46*(2), 143-149.

Kümmel, J., Kramer, A., Giboin, L.S., & Gruber, M. (2016). Specificity of Balance Training in Healthy Individuals; A Systematic Review and Meta-Analysis. *Sports Medicine, 46*(9), 1261-1271.
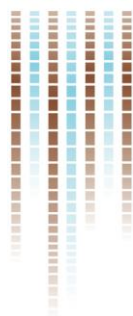
Title

Monitoring of physical fitness of all first graders in Basel-Stadt – the Sportcheck

Authors/Affiliation

Katharina Endes[1], Till Schmidlin[1] & Lukas Zahner[1]

[1]Department of Sport, Exercise and Health, University of Basel, Switzerland

Abstract

Introduction

12.5% of the girls and 27.8% of the boys in Switzerland met the global physical activity recommendation of 60 minutes a day (Verloigne et al., 2012). Besides 14% of the Swiss children were overweight and 3.4% obese (Murer, Saarsalu, Zimmermann, & Aeberli, 2014). Regular physical activity is known to play a decisive role in the prevention and treatment of risk factors for cardiovascular diseases and musculoskeletal injuries already in young age (Janssen & Leblanc, 2010). Against this background, the canton of Basel-Stadt decided to invest in health promotion and started in 2014 a continuous yearly monitoring, that includes physical fitness tests and measurements of height and body weight of every first grader in Basel-Stadt, called Sportcheck. The aim of the monitoring was to draw maps of the prevalence of overweight/obesity and physical fitness of the children of every school. The Cantonal Office of Sport of Basel-Stadt can therefore support schools with a consisting low level of physical fitness with either further education for the teachers or with additional physical educations lessons developed for the specific children's needs of the respective school.

Methods

3994 children (mean age: 7.3; SD 0.4) conducted measurements of body weight and height, a 20 m shuttle run, a 20 m sprint, jumping sidewards, balancing backwards. The geographic information system ArcMap 10.2.1 (Esri ArcGIS) was used to map the overweight/obesity status and the physical fitness of the children. To provide an overall estimate of physical fitness a summary score as the average of z-scores of the four physical fitness tests was calculated. Z-scores for every physical fitness test were stratified by age and sex and calculated by school (Schouten, 2000). Z-scores were divided in quintiles to categorize the level of overweight/obesity, physical fitness respectively, in the Sportcheck cohort. The calculated z-scores were linked with the catchment area of the schools as a basis of the maps. Statistical differences between the means of the school and the mean of the whole cohort as a reference value and statistical differences between boys and girls within a school were analysed by using t-tests.

Results

Since there are 21 different schools, result will be presented in a map at the presentation. But there are differences in physical fitness and overweight/obesity between schools (p<0.001). Furthermore, in two school boys were physically fitter that girls and in one school girls were physically fitter than boys (p<0.001).

Discussion/Conclusion

After three years of testing in Basel-Stadt schools there are schools a lower physical fitness level with more overweight/obese children than others. The Cantonal Office of Sport was and still is adapting the physical education in the whole city based on the result of the Sportcheck. With a planned follow up study Basel-Stadt wants to evaluate the adaptations in physical education that are already conducted.

References

Janssen, I., & Leblanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act, 7*, 40. doi: 10.1186/1479-5868-7-40

Murer, S. B., Saarsalu, S., Zimmermann, M. B., & Aeberli, I. (2014). Pediatric adiposity stabilized in Switzerland between 1999 and 2012. *European Journal of Nutrition, 53*(3), 865-875. doi: 10.1007/s00394-013-0590-y

Schouten, H. J. (2000). Combined evidence from multiple outcomes in a clinical trial. *J Clin Epidemiol, 53*(11), 1137-1144.

Verloigne, M., Van Lippevelde, W., Maes, L., Yildirim, M., Chinapaw, M., Manios, Y., . . . De Bourdeaudhuij, I. (2012). Levels of physical activity and sedentary time among 10- to 12-

93

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Physical activity in school children

year-old boys and girls across 5 European countries using accelerometers: an observational study within the ENERGY-project. *Int J Behav Nutr Phys Act, 9*, 34. doi: 10.1186/1479-5868-9-34

Title

Regional sociocultural differences as important correlate of physical activity and sedentary behaviour in Swiss preschool children

Authors/Affiliation

Claudia S. Leeger-Aschmann[1], Einat Schmutz[1], Thomas Radtke[1], Tanja H. Kakebeeke[2,3], Annina Zysset[2], Nadine Messerli-Bürgy[4,5], Kerstin Stülb[4], Amar Arhab[5], Andrea Meyer[6], Simone Munsch[3], Oskar G. Jenni[2], Jardena J. Puder[4,6] and Susi Kriemler[1]

[1] Epidemiology, Biostatistics and Prevention Institute, University of Zurich, CH ; [2] Child Development Centre, Children University Hospital of Zurich, Zurich, CH ; [3] Children's Research Centre, University Children's Hospital Zurich, Zurich, CH ; [4] Department of Clinical Psychology and Psychotherapy, University of Fribourg, Fribourg, CH ; [5] Service d' Endocrinologie, Diabétologie et Métabolisme, Centre Hospitalier Universitaire Vaudois , University of Lausanne, Lausanne, CH ; [6] Department of Psychology, University of Basel, Basel, CH; [7] Devision of Paediatric Endocrinology, Diabetology and Obesity, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, CH

Abstract

Introduction

Regional differences in physical activity (PA) in school-aged children and adults even within one country with the same political and health care system were observed and could not be explained by socio-demographic or individual variables. We analysed whether such differences were already present in pre-schoolers.

Methods

Swiss children from 84 childcare centres in 5 cantons (Aargau, Bern, Fribourg, Vaud, Zurich) comprising about 50% of the country's population participated. PA was quantified by accelerometers (ActiGraph, wGT3X-BT) and potential correlates were assessed with measurements at the childcare centre or questionnaires. Mixed regression models were used to test associations between potential correlates of total PA (TPA), moderate-to-vigorous PA (MVPA), light PA (LPA) or sedentary behaviour (SB) with a special focus on regional differences.

Results

394 of 476 children (83%) provided valid PA data (at least 2 week- and 1 weekend-day with 10h recording; mean age 3.9±0.7 years, 54% boys) with 26% and 74% living in the French- and German-speaking parts, respectively. Days consisted of (mean±SD) 1.6±0.5h MVPA, 5.0±0.6h LPA, and 6.2±0.8h SB with an average of 624±150 counts/min TPA. TPA and MVPA (but not SB or LPA) increased with age, were higher in boys and children with better motor skills. Despite controlling for individual characteristics, familial factors and childcare exposure, children from the French-speaking part of Switzerland showed 13% less TPA, 14% less MVPA, 6% less LPA and 8% more SB than German-speaking children.

Conclusion

Beside motor skills and non-modifiable individual factors, the regional socio-cultural difference was the most important correlate of PA and SB. Therefore, regionally adapted public health strategies may be needed.

References

Leeger-Aschmann CS, Schmutz EA, Radtke T, Kakebeeke TH, Zysset AE, Messerli-Bürgy N, Stülb K, Arhab A, Meyer AH, Munsch S, Jenni OG, Puder JJ & Kriemler S. Regional sociocultural differences as important correlate of physical activity and sedentary behaviour in Swiss preschool children. _Swiss Medical Weekly (in press)._

95

Title

Disease, Activity and Schoolchildren's Health (DASH) in Port Elizabeth, South Africa: Selected baseline results

Authors/Affiliation

Ivan Müller[1,2], Stefanie Gall[1], Jürg Utzinger[2], Cheryl Walter[3] and Uwe Pühse[1]

[1]_Department of Sport, Exercise and Health, University of Basel, Basel, Switzerland; _[2]_Swiss Tropical and Public Health Institute, Basel, Switzerland; _[3]_Nelson Mandela Metropolitan University, Port Elizabeth, South Africa._

Abstract

Introduction

As traditional lifestyle and diets change with social and economic development, deprived communities in low- and middle-income countries increasingly face a double burden of communicable and non-communicable diseases. We studied the relationship between physical fitness and infections with soil-transmitted helminths (STHs) and cognitive performance among schoolchildren in Port Elizabeth, South Africa.

Methods

We conducted a cross-sectional survey among approximately 1000 children, aged 9 to 12 years, from eight primary schools in socioeconomically disadvantaged neighbourhoods of Port Elizabeth. Physical fitness was determined using tests of the Eurofit fitness test battery. Children's school grades were obtained and the d2 test of attention was used to determine attention capacity as a measurement for cognitive performance. Stool samples were analysed with the Kato-Katz thick smear technique to diagnose STHs. Haemoglobin (Hb) levels were assessed and anthropometric indicators determined.

Results

In two schools, high STH prevalences were found (_Ascaris lumbricoides_ 60 and 72%; _Trichuris trichiura_ 65% each). For boys and girls co-infected with _A. lumbricoides_ and _T. trichiura_ (n=155) the maximal oxygen uptake (VO$_2$ max) was estimated to be 50.1 and 47.2 ml kg^{-1} min^{-1}, compared to 51.5 and 47.4 ml kg^{-1} min^{-1} for their non-infected peers (n=278), respectively. Children with helminth infection, irrespective of age or sex, had a lower concentration performance score (43.3 vs. 59.5), a higher percentage of errors (20.9 vs. 14.9) and poorer school grades (3.2 vs. 4.4). Similar results were found when comparing stunted children and normal children. Overall, a significant ($P<0.05$) positive association was found between selective attention and cardiorespiratory fitness and a negative association between selective attention and helminth infection. On average, children without helminth infections had greater body mass ($P=0.011$), height ($P=0.009$) and a higher body mass index ($P=0.024$) and were less often stunted ($P=0.006$), but not significantly less wasted compared to their peers with a single or dual species infection. Among 9-year-old boys, a negative correlation between helminth infections and VO$_2$ max, grip strength and standing broad jump distance was observed ($P=0.038$). The overall mean Hb level was 122.2 g l^{-1}. In the two schools with the highest prevalence of STHs the Hb means were 119.7 and 120.5 g l^{-1}, respectively.

Discussion/Conclusion

Intestinal parasite infections appear to have a small but significant negative effect on the physical fitness of infected children, as expressed by their maximal oxygen uptake. Stunting stemming from malnutrition as well as soil-transmitted helminth infections seem to hamper children's cognitive performance and their selective attention. We observed a clear impact on anthropometric indicators.

References

- Gall, S., Müller, I., Walter, C., Seelig, H., Steenkamp, L., Pühse, U., . . . Gerber, M. (2017). The impact of infection status, stunting, food insecurity/hunger, socio-economic status and physical fitness on selected attention in socio-economically disadvantaged neighbourhoods in Port Elizabeth, South Africa: a cross-sectional survey. To appear in _INT J PUBLIC HEALTH_
- Müller, I., Yap, P., Steinmann, P., Damons, B. P., Schindler, C., Seelig, H., . . . Utzinger, J. (2016). Intestinal parasites, growth and physical fitness of schoolchildren in poor neighbourhoods of Port Elizabeth, South Africa: a cross-sectional survey. _Parasit Vectors, 9_(1), 488. doi:10.1186/s13071-016-1761-5

Physical activity in school children

- Yap, P., Müller, I., Walter, C., Seelig, H., Gerber, M., Steinmann, P., . . . Pühse, U. (2015). Disease, activity and schoolchildren's health (DASH) in Port Elizabeth, South Africa: a study protocol. *BMC Public Health, 15*(1), 1285. doi:10.1186/s12889-015-2636-y
- Website: www.dash-sa.com

Webcam presentation: https://www.youtube.com/watch?v=SZ9pik2nlFQ&feature=youtu.be

Sport Economics

Title

The role of major sport events: an assessment of international sport federations' event portfolio and economic model

Authors:
Josephine Clausen[1], Emmanuel Bayle[1]
[1]Institut des Sciences du Sport, University of Lausanne, Switzerland

Abstract:
Introduction:
More than 100 years ago, the first international sport federations (IF) were created to set up supervise and sanction international rules of the game, and to promote and develop the sport worldwide. For many decades, these federations were characterised by volunteer structures organised with small financial resources (e.g. from membership fees). Over the last 30 years, this picture has changed radically: in most IFs, administration (and sometimes even politics) moved entirely into the hands of paid professionals; the trend towards sport spectacles and commercialisation (Robinson, 2008) have turned major sport events (e.g. World Championships) into an important source of income; and to ensure the development and viability of a profitable economic model, IFs implement rationalised management practices (e.g. strategic planning, project management). Today, IFs are still nonprofit associations whose mission is to govern and develop their sport, but they have also become global economic actors with important revenues in some cases. IF's major events occupy a pivotal role in this evolution. In light of IF's increasing business-orientation (Dowling, Edwards, & Washington, 2014), the line between means and ends no longer seems clear-cut: is maximum profit the means to develop, promote and organise the sport? Or are development, promotion and organisation of the sport the means to generate maximum profit? In this study, we seek to gain a better understanding of IF's event portfolio (e.g. major events, strategic priorities), its economic model and how the latter benefits or not IF members (e.g. profit distribution model).

Methods:
To assess IFs event portfolio as well as their economic model (including profit distribution), we draw on various theoretical perspectives such as organisational performance management (e.g. how to use available resources efficiently (O'Boyle, 2015)) or Parent and Séguin's (2008) model of brand creation for international large-scale sporting events. 18 summer Olympic IFs were analysed regarding their resource acquisition (revenues), distribution (expenses) and formulation of strategic goals.

Discussion/Conclusion:
Various studies exist that focus on mega sport events in terms of legacy, event image and branding, consumer behaviour, etc. Assuming a shift within IFs towards increased business logics, this study suggests a new perspective on mega sport events. This new perspectives is based on IF's strategic incentives to create, organise and commercialise major sport events.

References:

Sport Economics

Title

Costs resulting from injuries in amateur and informal soccer in Switzerland

Authors/Affiliation

Angela Gebert[1,2], Uwe Pühse[2], Markus Gerber[2], Gassmann Philippe[3], Markus Lamprecht[1]

[1]Lamprecht und Stamm Sozialforschung und Beratung, Zürich, Schweiz; [2]Departement für Sport, Bewegung und Gesundheit, Universität Basel, Schweiz; [3]Suva, Luzern, Schweiz

Abstract

Introduction

The health benefits of sport participation are undisputed. However, participating in sports also comes with the risk of injury. A detailed cost model of the whole spectrum of minor and severe injuries in the Netherlands identified soccer injuries of young males as particularly cost-intensive (Polinder et al., 2016). In Switzerland 40% of all sport injuries happen during ball games and out of these 64% are a consequence of soccer play (KSUV, 2016). As a result, 48'000 soccer injuries were counted amongst the working population in 2014 causing costs of approximately CHF 180 Mio. Consequently, soccer injuries constitute an important public health problem and cause a high economic burden. Nevertheless, there is a lack of knowledge with regard to subgroups, injury types and injury situations causing healthcare costs and loss of productivity. Therefore, the aim of the present study was to provide this information in order to support the development of cost-effective prevention strategies.

Methods

The Swiss National Accident Insurance Fund (Suva) annually records 30'000 soccer injuries (KSUV, 2016) of which a random sample of 2835 persons was drawn with the aim of interviewing approximately 800 persons. Finally, 822 persons who had sustained a soccer injury between July 1, 2013 and June 31, 2014 and reported this accident to the Suva were retrospectively contacted. The standardised telephone survey was carried out in two phases with the intention of reducing the interval between the accident and the interview. An interview took 16 minutes on average. Ultimately, 702 injuries could be linked with their costs one year after the accident.

Results

The median costs of an injury in amateur and informal soccer were CHF 932 (IQR = 2982). All in all, the analysed injuries led to total costs of CHF 3'328'476 consisting of CHF 1'726'517 treatment costs and CHF 1'601'960 for lost working time. Male players (n=659, 94%) caused higher median costs (CHF 951, IQR = 3154) than female players (CHF 426, IQR = 1098, p = 0.012). While only responsible for 35% of soccer injuries persons aged 30 years and older accounted for nearly half (49%) of all injury costs. 58% of all costs were the result of injuries which occurred during games of the official championship (17% soccer club training, 25% informal soccer). Additionally, injuries that happened during the first halftime caused comparatively high median costs of CHF 1487 (IQR = 5586, p < 0.001). Foul play injuries led to 26% of all injury costs, but their median costs of CHF 769 (IQR = 2641) did not differ significantly from those of self-inflicted and other contact injuries (p = 0.224). However, twisting and turning injuries caused high median costs (CHF 1618, IQR = 18'263, p = 0.001) compared to other injury situations. Knee injuries accounted for 24.8% of all reported injuries but were responsible for 53.2% of the costs. The corresponding median cost of a knee injury was CHF 3377 (IQR = 16'431) and thus significantly higher than for injuries of other body regions (p < 0.001).

Discussion/Conclusion

Our findings suggest that preventive measures targeting the reduction of healthcare costs of soccer injuries should address male persons aged 30 years and older. Furthermore, knee injuries accounted for an essential proportion of the costs (de Loës et al., 2000) and as a consequence, preventive measures need to focus even more on this body region as well as twisting and turning situations. Finally, prevention strategies should also focus on the reduction of injuries during games of the official championship by promoting a fair and safe play.

References

de Loës, M., Dahlstedt, J.L., & Thomée, R. (2000). A 7-year study on risks and costs of knee injuries in male and female youth participants in 12 sports. Scandinavian Journal of Medicine & Science in Sports, 10, 90-97.
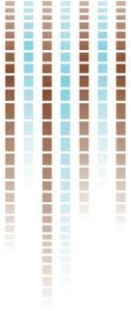
Sport Economics

KSUV. Sammelstelle für die Statistik der Unfallversicherung UVG. Unfallstatistik UVG 2016. Berneck, 2016.

Polinder, S., Haagsma, J., Panneman, M., Scholten, A., Brugmans, M., & Van Beeck, E. (2016). The economic burden of injury: Health care and productivity costs of injuries in the Netherlands. Accident Analysis and Prevention, 93, 92-100.

Sport Economics

Title

Modeling international sporting success of nations. Do national sport policy factors significantly improve the fit?

Authors/Affiliation

Anne Renaud[1], Veerle De Bosscher[2], Hippolyt Kempf[1]

[1]Swiss Federal Institute of Sport Magglingen, Magglingen, Switzerland; [2]Vrije Universiteit Brussel, Brussel, Belgium

Abstract

Introduction

Policy makers aim to better understand factors that determine sporting success. On one hand, studies have found a number of socio-economic factors such as GDP per capita or population size reliable predictors of how well a country do in international sporting events (De Bosscher et al., 2006; Bredtmann et al., 2016). On the other hand, national sports policies factors such as public expenditure on sport have been shown to be correlated to the international sporting success (De Bosscher et al, 2015). This paper aims to clarify the role of sport policies factors to describe the international winter and summer sporting success, respectively. Additionally, it evaluates the impact of a climate factor as a proxy for possible winter or summer sports tradition. Do policy factors significantly improve the fit when added to socio-economic variables? Should a climate factor be included to better describe the success in winter and summer sports? The study applied a multivariate approach to collect new evidence about international sporting success factors.

Methods

The analysis applied multiple linear regression for summer and winter sporting success, respectively. The dependent success variables were the medal shares during the time period 2009-2012 (Olympic Games and World Championships). Two sets of dependent variables were defined. The set of macro-level variables was composed of GDP per capita, population size and an indicator based on global climate data. The set of meso-level variables was retrieved from the project SPLISS 2.0 (Sports Policy factors Leading to International Sporting Success; De Bosscher et al, 2015). The nine SPLISS composite indicators – such as finance or talent identification - were available for 16 countries/regions. In a preliminary step, the dimension of the meso-level indicators was reduced by using principal component analysis (PCA). The objective was to remain within the overall limit of five independent variables to model the 16 SPLISS countries/regions. Models were evaluated and compared by using adjusted R-squared, AIC and BIC, as well as ANOVA.

Results

The full model with all macro-level and meso-level independent variables fitted very well for summer sports (R-squared=0.91) and well for winter sports (R-squared=0.77). The meso-level factors did significantly improve the fit for summer sports (p<0.01) but not for winter sports (p=0.51) when compared to the model with only macro-level variables. The climate factor has been shown to be significant to describe the success for winter sports (p<0.01) but not for summer sports.

Discussion/Conclusion

The study provides some evidence of the impact of meso-level sport policy to describe the international sporting success in addition to macro-level factors; but only for summer sports. Yet, the study relies on a small data set of 16 countries/regions. A generalization would require further study with available sport policy factors for a larger data set of countries. Another finding is the impact of the climate factor only for winter sports. This result suggests that a possible tradition for winter sports does not lead to the reduction of the performance in summer sports.

References

Bredtmann, J., Crede, C. J. & Otten, S. (2016) Olympic medals: Does the past predict the future? *Significance*, 13 (3), 22-25.

De Bosscher, V., De Knop, P., Van Bottenburg, M. & Shibli, S. (2006). A Conceptual Framework for Analysing Sports Policy Factors Leading to International Sporting Success. *European Sport Management Quarterly*, 6(2), 185-215.

Sport Economics

De Bosscher, V., Shibli, S., Westerbeek, H. & Van Bottenburg, M. (2015). *Successful elite sport policies. An international comparison of the sports policy factors leading to international sporting success (SPLISS 2.0) in 15 nations*. Maidenhead: Meyer & Meyer.
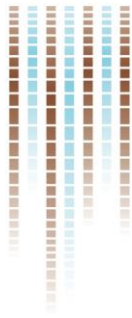
Movement Perception

Title

Even if you hide, I know what you are doing: contextual cues induce muscle specific modulation in M1 in the absence of observed movement kinematics

Authors/Affiliation

Andreea Loredana Cretu[1], Maria German[1], Kathy Ruddy[1], Nicole Wenderoth [1]
[1]Neural Control of Movement Lab, ETH Zurich, Switzerland

Abstract

Introduction

Observers are able to predict the action intentions of other people in a seemingly effortless way. Transcranial magnetic stimulation (TMS) studies consistently demonstrated that the observer's primary motor cortex (M1) becomes facilitated in a muscle-specific manner and that excitability changes are time-locked to the observed kinematics as movements unfold (Alaerts, de Beukelaar, Swinnen, & Wenderoth, 2012; Cavallo, Heyes, Becchio, Bird, & Catmur, 2014; Gangitano, Mottaghy, & Pascual-Leone, 2004). However, when informative cues are available before the initiation of movement, anticipatory motor activity is observed even before the actual kinematics are visible (de Beukelaar, Alaerts, Swinnen, & Wenderoth, 2016). Here, we explored whether these muscle-specific modulations in corticospinal activity occur in conditions in which the movement kinematics are not shown at all. We looked at differences in the modulation of motor-evoked potentials (MEPs) measured by single-pulse TMS to M1 while participants observed either whole-hand (WHG) or precision grasping (PG) actions with or without grasp-specific kinematics.

Methods

24 healthy subjects participated in the present study (7 males; mean age: 24 ± 5). MEPs were recorded from the First Dorsal Interosseous (FDI) and Abductor Digiti Minimi (ADM) muscles using surface electromyography and TMS was performed with a 70mm figure-of-eight coil connected to a Magstim 200 stimulator.

Stimuli

The visual stimuli consisted of video clips showing the right hand of a female actor reaching, grasping and lifting a round jar, either with a WHG or PG. Importantly, at the start of each trial, either a blue or white square (precue) was presented on the screen, indicating that the upcoming grasping action would involve a whole-hand or PG, respectively. To ensure participants' attention to the precues and upcoming grips, *catch* trials containing incorrect cues were present in 4% of all trials. At the end of each trial, participants were asked to verbally indicate whether the cue was correct or not. However, in almost half (48%) of the movies, the hand – object interaction was covered with a black square during the grasping and lifting phase, so the accuracy of the cues could not be judged (*covered* condition).

The experiment contained 3 video types (covered, uncovered, catch) presented in 15 randomized blocks, each containing 20 videos. For each of the 12 conditions [2 grip types (WHG, PG) x 3 phases (reach, grasp, lift) x 2 video types (uncovered, covered)], 24 MEPs were recorded, resulting in a total of 288 MEPs for each subject and each muscle (FDI, ADM). For the *catch* trials, MEPs were recorded only during the grasp phase because these trials were removed from the final analysis.

Data analysis and statistics

The peak-to-peak amplitude of the MEPs was calculated from the EMG data. Since background EMG activation can influence the size of the MEPs, all the MEPs containing high background values (>0.01mV) were removed from further analysis (3.3% of all trials).

To determine whether M1 excitability was modulated in a grip-specific manner, a ratio was calculated by dividing the MEP mean amplitude collected while observing a WHG by the MEP mean amplitude while observing a PG (ratio = MEP_{WHG}/MEP_{PG}), separately for each muscle. To be more specific, a ratio higher than 1 indicates a stronger facilitation during WHG observation, a value lower than 1 indicates a stronger facilitation during PG observation, while a ratio equal to 1 indicates no muscle-specific facilitation/inhibition. Ratios were calculated for each subject and condition and subjected to statistical analyses.

Movement Perception

Due to high inter-individual variability of MEP measures and to the fact that the data were not normally normally distributed (Shapiro-Wilk tests, p<.05), the results were analyzed using linear mixed-effect models to assess the effect of video (covered, uncovered), phase (reach, grasp, lift) and muscle (FDI, ADM) on the cortico-motor excitability while observing a WHG versus precision grip (MEP_{WHG}/MEP_{PG}). Additionally, we used non-parametric analysis, including Friedman ANOVA and Wilcoxon tests.

Results

MEP ratios differed significantly in the two muscles (p <.001): ADM MEPs were more facilitated than FDI MEPs when observing WHG versus PG. In contrast, the type of video or the phase of movement did not have any effect on the cortico-spinal excitability and no interaction was significant, indicating that the effect of grip-type on corticospinal-excitability in the two muscles was the same irrespective of the video type (covered or uncovered) and of the phase of the grasp (Reach, Grasp, Lift). Wilcoxon signed-rank tests showed that ADM ratios were significantly higher than FDI ratios indicating that ADM muscle is more strongly modulated by the observation of WHG and FDI muscle is more strongly modulated by PG.

Discussion/Conclusion

The present study aimed to investigate whether the presence of muscle-specific kinematics is necessary for the modulation of M1 during the observations of whole-hand versus precision grasping action. Importantly, in our experiments, both WHG and PG actions were associated with specific color cues which were learned before the start of the experiment.

Our preliminary results indicate that FDI and ADM muscle responses are differentially modulated in function of the grasp type indicated by the contextual cue. Moreover, there is no difference between the muscle-specific modulation in M1 when participants observe covered or uncovered videos, suggesting that grip-specific changes in corticomotor excitability are present even in the absence of movement kinematics. Using the uncovered condition, we were able to replicate previous findings which indicated that M1 is modulated in a muscle-specific manner during the observation of grasping and lifting movements but also that, anticipatory muscle-specific modulation can be observed during the early reach phase if informative cues are showed before the start of a movement. (de Beukelaar et al., 2016).

The general idea is that action observation automatically triggers action simulation and by this, action observation facilitates action execution (Jeannerod, 2001). One important aspect is that observation of actions facilitates the motor system and may result in the same plastic changes as actual physical exercise, therefore, it can have a positive impact on recovery of motor function (Ertelt et al., 2007; Mulder, 2007). In addition, action observation can be used as a strategy for learning novel tasks having important applications for sports training and neurorehabilitation (Ertelt & Binkofski, 2012; Gatti et al., 2013)

Here, we argue that when participants receive informative cues, corticomotor excitability changes in a grip-specific manner become visible even in the absence of kinematic cues. So the reenactment of an action can happen even when the movement kinematics are not explicitly showed, pointing to the fact that after learning a cue-grasp association, the presence of the learned cue is sufficient for predicting observed action intentions. These results can further optimize action observation therapies.

References

Alaerts, K., de Beukelaar, T. T., Swinnen, S. P., & Wenderoth, N. (2012). Observing how others lift light or heavy objects: Time-dependent encoding of grip force in the primary motor cortex. *Psychological Research*, *76*(4), 503–513. https://doi.org/10.1007/s00426-011-0380-1

Cavallo, A., Heyes, C., Becchio, C., Bird, G., & Catmur, C. (2014). Timecourse of mirror and counter-mirror effects measured with transcranial magnetic stimulation. *Social Cognitive and Affective Neuroscience*, *9*(8), 1082–1088. https://doi.org/10.1093/scan/nst085

de Beukelaar, T. T., Alaerts, K., Swinnen, S. P., & Wenderoth, N. (2016). Motor facilitation during action observation: The role of M1 and PMv in grasp predictions. *Cortex*, *75*, 180–192. https://doi.org/10.1016/j.cortex.2015.11.009

Ertelt, D., & Binkofski, F. (2012). Action observation as a tool for neurorehabilitation to moderate

Movement Perception

motor deficits and aphasia following stroke. *Neural Regeneration Research*, *7*(26), 2063–2074. https://doi.org/10.3969/J.ISSN.1673-5374.2012.26.008

Ertelt, D., Small, S., Solodkin, A., Dettmers, C., McNamara, A., Binkofski, F., & Buccino, G. (2007). Action observation has a positive impact on rehabilitation of motor deficits after stroke. *NeuroImage*, *36*, T164–T173. https://doi.org/10.1016/j.neuroimage.2007.03.043

Gangitano, M., Mottaghy, F. M., & Pascual-Leone, A. (2004). Modulation of premotor mirror neuron activity during observation of unpredictable grasping movements. *European Journal of Neuroscience*, *20*(8), 2193–2202. https://doi.org/10.1111/j.1460-9568.2004.03655.x

Gatti, R., Tettamanti, A., Gough, P. M., Riboldi, E., Marinoni, L., & Buccino, G. (2013). Action observation versus motor imagery in learning a complex motor task: A short review of literature and a kinematics study. *Neuroscience Letters*, *540*, 37–42. https://doi.org/10.1016/j.neulet.2012.11.039

Jeannerod, M. (2001). Neural Simulation of Action: A Unifying Mechanism for Motor Cognition. *NeuroImage*, *14*(1), S103–S109. https://doi.org/10.1006/nimg.2001.0832

Mulder, T. (2007). Motor imagery and action observation: Cognitive tools for rehabilitation. *Journal of Neural Transmission*, *114*(10), 1265–1278. https://doi.org/10.1007/s00702-007-0763-z

Rizzolatti, G., & Sinigaglia, C. (2010). The functional role of the parieto-frontal mirror circuit: interpretations and misinterpretations. *Nature Reviews Neuroscience*, *11*(4), 264–274. https://doi.org/10.1038/nrn2805

Movement Perception

Title

Körpersprache oder Informationen zur Spielerqualität? – eine Experimentalstudie zu Einflussfaktoren der Erfolgszuversicht von Sportteams

Authors/Affiliation

Kirstin Seiler[1], Geoffrey Schweizer[2], Roland Seiler[1]

[1]Institut für Sportwissenschaft, Universität Bern, Bern, Schweiz; [2]Institut für Sport und Sportwissenschaft, Ruprecht-Karls-Universität, Heidelberg, Deutschland

Abstract

Introduction

Studien zeigen, dass Nonverbales Verhalten (NVV) im Sport – beispielsweise Dominanz und Unterwürfigkeit – u.a. Einschätzungen über leistungsrelevante Charakteristika (Furley, Moll, & Memmert, 2015) und die Erfolgserwartung von Beobachtenden (Furley, Dicks, & Memmert, 2012) beeinflusst. Eine mögliche Erklärung könnte die schemabasierte Verarbeitung von Informationen sein, welche dazu beiträgt, dass Dominanz mit positiven, Unterwürfigkeit dagegen mit negativen Eigenschaften assoziiert wird (Furley et al., 2012). Diese Studien wurden jedoch in einem künstlichen Setting durchgeführt, in welchem _demand_-Effekte eine wichtige Rolle für die grossen Effektstärken und die schemabasierte Informationsverarbeitung spielen könnten. Ziel der zweiteiligen Experimentalstudie war es zu prüfen, inwieweit sich Teamsportler vom NVV ihrer Mitspieler und des Gegners beeinflussen lassen, wenn ihnen zusätzlich objektive Informationen zur Spielerqualität und damit Optionen zu einer datengetriebenen Informationsverarbeitung zur Verfügung stehen.

Methods

Für beide Experimente wurden 24 Videos erstellt, in welchen sich je 12 männliche und 12 weibliche Fussballer jeweils in einer dominanten und einer unterwürfigen Körperhaltung persönlich vorstellen. In Experiment 2 erhielten die Teilnehmer zusätzlich zu Variationen in der Körpersprache entweder positive oder negative Informationen (hohe oder niedrige Punktzahl) über die Qualität des Spielers im Video. _N_ = 80 Sportstudierende in Experiment 1 und _N_ = 61 Sportstudierende in Experiment 2 sahen in einem vollständig randomisierten Design jeweils sechs dominante und sechs unterwürfige Videos ihres entsprechenden Geschlechts. Auf einer 11-stufigen Skala von _0%-100% zuversichtlich_ mussten sie angeben, wie zuversichtlich sie sind, mit ihrem Team in einem anstehenden Aufstiegsspiel zu gewinnen, wenn der Spieler im Video in den Mannschaftskader des eigenen oder des gegnerischen Teams berufen werden würde.

Results

In Experiment 1 zeigt eine 2 (NVV: dominant, unterwürfig) x 2 (Perspektive: Mitspieler, Gegenspieler) ANOVA mit Messwiederholung auf beiden unabhängigen Variablen, dass die Erfolgszuversicht in der dominanten Bedingung signifikant höher ist als in der unterwürfigen Bedingung, wenn der Spieler im Video ein Mitspieler ist, die Erfolgszuversicht in der dominanten Bedingung dagegen signifikant niedriger ist als in der unterwürfigen Bedingung, wenn der Spieler im Video ein Gegner ist. Eine messwiederholte 2 (NVV: dominant, unterwürfig) x 2 (Perspektive: Mitspieler, Gegenspieler) x 2 (Spielerqualität: positiv, negativ) ANOVA in Experiment 2 zeigte einen signifikanten Interaktionseffekt und grosse Effektstärken für die Interaktion Perspektive x Informationen, die Interaktion Perspektive x Körpersprache war dagegen im Unterschied zu Experiment 1 nicht mehr signifikant. Die Erfolgszuversicht ist also signifikant höher, wenn positive Informationen über einen Mitspieler oder negative Informationen über einen Gegner gegeben werden.

Discussion/Conclusion

Die Ergebnisse bestätigen bisherige Befunde zur Bedeutung von NVV. Denn Körpersprache hat einen entscheidenden Einfluss auf die Erfolgszuversicht, wenn nur ein Kriterium zur Entscheidungsfindung zur Verfügung steht. Bei Ergänzung des objektiven Kriteriums der Spielerqualität wird die Erfolgszuversicht von Sportteams dagegen vor allem durch dieses Kriterium bestimmt, die Körpersprache spielt keine entscheidende Rolle mehr. Zukünftige Forschung sollte weitere Faktoren untersuchen, welche den Zusammenhang zwischen NVV und Erfolgszuversicht beeinflussen können. Praktische Implikationen werden diskutiert.

References

Movement Perception

Furley, P., Moll, T., & Memmert, D. (2015). "Put your Hands up in the Air"? The interpersonal effects of pride and shame expressions on opponents and teammates. Frontiers, 6, 1361.

Furley, P., Dicks, M., & Memmert, D. (2012). Nonverbal behavior in soccer: The influence of dominant and submissive body language on the impression formation and expectancy of success of soccer players. *Journal of Sport and Exercise Psychology, 34,* 61-82.

Movement Perception

Title

You can track but not detect: How attention alters change-detection rates in MOT

Authors/Affiliation

Christian Vater, Ralf Kredel, Ernst-Joachim Hossner
Institute of Sport Science, University of Bern, Bern, Switzerland

Abstract

Introduction

In sports it is often required to pay attention to multiple moving objects in the environment (Williams, Janelle & Davids, 2004). Nevertheless, it should be possible to react on certain environmental changes (e.g., to play a pass to a free player). In the current study, we investigated how attention alters detection rates of changes on to-be-tracked targets vs. non-targets (distractors) in a Multiple Object Tracking (MOT) task. It could be expected that peripheral vision is used for target monitoring and target-change detection, so that covert attention is distributed to the targets (Vater, Kredel, & Hossner, 2016a). Moreover, due to the motion sensitivity of peripheral vision, motion changes should be better detected than form changes, especially at far eccentricities (Vater, Kredel, & Hossner, 2016b). The current experiment will show, whether the location of attention alters previously reported detection rates.

Methods

12 participants were tested in a MOT task, in which 4 out of 10 squares have to be tracked. For a secondary change-detection task, participants pressed a button in case one of the 10 squares stopped or changed its form (from square to diamond). Object-change eccentricities were either near (< 10 °) or far (> 15 °) from the centroid (center of mass of the four targets). An integrated mobile eye-tracking system was used to measure participants' gaze behavior (EyeSeeCam, 220 Hz), to calculate percentage of detections with peripheral vision. Change-detection rates as well as peripheral detections were analyzed with a change location (target vs. distractor) x eccentricity (near vs. far) x change type (stop vs. form) ANOVA with repeated measures on all factors.

Results

Main effects for change location, eccentricity and change type were observed (all ps < .01, η_p^2 > .70). Target changes were more often detected than distractor changes, stop changes were better detected than form changes and near changes were better detected than far changes. A three-way interaction was also revealed (p < .01, η_p^2 = .54). Although detection rates for stop and form changes of distractors were lower than for targets at near eccentricities, they did not differ significantly. In contrast, detection rates for form changes of distractors were lower than for motion changes of distractors at far eccentricities. The percent of peripheral detections did neither differ for change type nor for change location (both p > .27) and was overall at about 90 %.

Discussion/Conclusion

The current results highlight the influence of attention on detection rates of object changes that either regard attended objects (targets) or unattended objects (distractors). Since distractor changes were missed more often, attention seems to be linked to objects rather than space (like a spotlight). A transfer to sports is planned to explain, e.g., why a pass to better positioned player might be missed.

References

Vater, C., Kredel, R., & Hossner, E. J. (2016a). Detecting single-target changes in multiple object tracking: The case of peripheral vision. _Attention, Perception, & Psychophysics, 78_, 1004-1019.

Vater, C., Kredel, R., & Hossner, E. J. (2016b). _Detecting target changes in multiple object tracking with peripheral vision: More pronounced eccentricity effects for form than for motion changes_. Manuscript submitted for publication.

Williams, A. M., Janelle, C. M., & Davids, K. (2004). Constraints on the search for visual information in sport. _International Journal of Sport and Exercise Psychology, 2_, 301-318.

Title

Acute cognitively engaging exergaming improves cognitive flexibility performance in adolescents

Authors/Affiliation

Valentin Benzing[1], Theda Heinks[2], Noëmi Eggenberger[2], Mirko Schmidt[1]
[1]Institute of Sport Science, University of Bern, Bern, Switzerland; [2]Pediatric Neuropsychology, Bern Children´s University Hospital, Inselspital, Switzerland

Abstract

Introduction

A wide range of literature demonstrates the beneficial effects of acute physical activity (PA) on executive functions (EFs) in children (Donnelly et al., 2016; Verburgh, Königs, Scherder & Osterlaan, 2014). Qualitative PA characteristics (Pesce, 2012) and in particular cognitive engagement (Schmidt, Benzing & Kamer, 2016) have been proposed as important factors influencing these benefits. However, in adolescents, there is limited and contradictory evidence available on acute effects of cognitive engaging PA on EFs. In general, very few studies (impaired by procedural differences) investigated the impact of cognitive engagement comprised in PA on cognition, whereof a majority did not use an operationalization of cognitive engagement (Tomporowski, McCullick, Pendleton & Pesce, 2015). Therefore, the present study aimed to elucidate the influence of cognitive engagement comprised in an acute bout of exergame-based PA on executive functions (inhibition, cognitive flexibility) in adolescents.

Methods

Sixty-five healthy male adolescents (M = 14.51; SD = 1.08) were randomly assigned to one of three conditions: (a) PA with high levels of cognitive engagement (Shape Up); (b) PA with low levels of cognitive engagement (Running); (c) sedentary with low levels of cognitive engagement (Control). Manipulation checks, including subjective (rating of perceived cognitive engagement) and objective operationalizations of cognitive engagement (heart rate variability), were applied. EFs were assessed before and after each condition using the D-KEFS design fluency test.

Results

Manipulation check analyses (ANOVAs) showed that intensity of PA was increased equally in the experimental groups compared to control, whereas cognitive engagement was elevated only in the Shape Up group (ps < .05). With regard to executive function performance, ANCOVAs (with pre-test values as covariates) revealed that only the Shape Up condition improved performance significantly with regard to cognitive flexibility (F(2, 61) = 3.50, p = .036, Eta^2 = .103), whereas inhibition performance did not differ between the three groups (p > .05).

Discussion/Conclusion

Cognitive flexibility was immediately enhanced by acute cognitively engaging PA. Thus, to promote benefits in cognitive performance, these results underline the important role cognitive engagement seems to play in PA. In addition, this study suggests a methodological approach to operationalize cognitive engagement in laboratory and field settings. Both the subjective as well as the objective measure might be a promising tool to investigate the construct of cognitive engagement in future studies.

References

Donnelly, J. E., Hillman, C. H., Castelli, D., Etnier, J. L., Lee, S., Tomporowski, P., … Szabo-Reed, A. N. (2016). Physical activity, fitness, cognitive function, and academic achievement in children. *Medicine & Science in Sports & Exercise*, *48*(6), 1197–1222.

Pesce, C. (2012). Shifting the focus from quantitative to qualitative exercise characteristics in exercise and cognition research. *Journal of Sport and Exercise Psychology*, *34*(6), 766–786.

Schmidt, M., Benzing, V., & Kamer, M. (2016). Classroom-based physical activity breaks and children's Attention: Cognitive engagement works! *Frontiers in Psychology, 7*, 1–13.

Tomporowski, P. D., McCullick, B., Pendleton, D. M., & Pesce, C. (2015). Exercise and children's cognition: The role of exercise characteristics and a place for metacognition. *Journal of Sport and Health Science*, *4*(1), 47–55.

Exercise and Cognition in Adolescents and Older Adults

Verburgh, L., Königs, M., Scherder, E. J. A., & Oosterlaan, J. (2014). Physical exercise and executive functions in preadolescent children, adolescents and young adults: a meta-analysis. *British Journal of Sports Medicine, 48*(12), 973–979.

Title

Exergame and Balance Training-Induced Functional Adaptions in the Prefrontal Cortex during Walking are Associated with Enhanced Executive Functions in Older Adults

Authors/Affiliation

Patrick Eggenberger[1], Martin Wolf[2], Martina Schumann[1] and Eling D. de Bruin[1]

[1]Institute of Human Movement Sciences and Sport, Department of Health Sciences and Technology, ETH Zurich, Zurich, Switzerland, [2]Biomedical Optics Research Laboratory, Department of Neonatology, University Hospital Zurich, Zurich, Switzerland

Abstract

Introduction

Different modalities of exercise training have the potential to induce structural and functional brain plasticity in the elderly. Thereby, training-induced functional brain adaptations were observed during cognitive tasks in functional magnetic resonance imaging studies and these adaptations correlated with improved cognitive performance (1-3). This study (4) aimed to investigate if two different modalities of exercise training induce functional brain plasticity during challenging treadmill walking and elicit associated changes in cognitive executive functions. We hypothesized, that cognitive-motor video game dancing (an exergame) would elicit larger training-induced reductions of prefrontal cortex (PFC) activity during walking compared to conventional balance training, and that training-induced changes in PFC activity would correlate with changes in executive functions.

Methods

Forty-two elderly participants were recruited and randomly assigned to either interactive cognitive-motor video game dancing (DANCE) or balance and stretching training (BALANCE). The 8-week intervention included three sessions of 30 min per week. PFC activity during preferred and fast walking speed on a treadmill was assessed pre- and post-intervention by measuring levels of oxygenated hemoglobin applying functional near infrared spectroscopy. Additionally, executive functions comprising shifting, inhibition, and working memory were assessed. Two-way repeated measures analyses of variance (ANOVA) were applied to analyse differences in PFC activity between pre- and post-test, or left vs. right hemisphere, or preferred vs. fast walking. Pearson's correlation was calculated to identify associations of PFC activity changes with cognitive performance changes.

Results

Thirty-three participants (mean age 74.9 ± 6.9 years) completed the intervention. Both interventions significantly reduced left and right hemispheric PFC activity during the acceleration of walking ($p<.05$ or trend, $r=.25–.36$), while DANCE showed a larger reduction at the end of the 30-s walking task compared to BALANCE in the left PFC [$F(1, 31) = 3.54$, $p=.035$, $r=.32$]. These exercise training induced modulations in PFC activity correlated with improved executive functions ($p<.05$ or trend, $r=.31–.50$).

Discussion/Conclusion

We conclude that the observed training-induced reductions in PFC activity during challenging walking may release cognitive resources to focus attention on other processes while walking. This appears to be an important neurophysiological effect, which could help to improve mobility and prevent falls in the elderly. This study provides a deeper understanding of the associations between exercise training, brain function during walking, and cognition in older adults.

References

1. Liu-Ambrose, T., Nagamatsu, L.S., Voss, M.W., Khan, K.M., & Handy, T.C. (2012). Resistance training and functional plasticity of the aging brain: a 12-month randomized controlled trial. _Neurobiol. Aging_, 33, 1690–1698. doi: 10.1016/j.neurobiolaging.2011.05.010

2. Voelcker-Rehage, C., Godde, B., and Staudinger, U.M. (2011). Cardiovascular and coordination training differentially improve cognitive performance and neural processing in older adults. Front. Hum. Neurosci. 5:26. doi: 10.3389/fnhum.2011.00026

3. Voss, M.W., Heo, S., Prakash, R.S., Erickson, K.I., Alves, H., Chaddock, L., et al. (2013). The influence of aerobic fitness on cerebral white matter integrity and cognitive function in older adults: results of a one-year exercise intervention. _Hum. Brain Mapp.,_ 34, 2972–2985. doi: 10.1002/hbm.22119

111

Exercise and Cognition in Adolescents and Older Adults

Eggenberger, P., Wolf, M., Schumann, M, & de Bruin, E.D. (2016). Exergame and Balance Training Modulate Prefrontal Brain Activity during Walking and Enhance Executive Function in Older Adults. *Front. Aging Neurosci.*, 8:66. doi: 10.3389/fnagi.2016.00066

Title

Prefrontal cortex-located cognitive and motor adaptions in healthy elderly following exergame and balance training: A randomized-controlled trial

Authors/Affiliation

Alexandra Schättin[1], Rendel Arner[1], Federico Gennaro[1], Eling D. de Bruin[1]
[1]Institute of Human Movement Sciences and Sport, ETH Zurich, Zurich, Switzerland

Abstract

Introduction

During aging, the prefrontal cortex (PFC) undergoes age-dependent neuronal changes influencing cognitive and motor functions (1). Motor-learning interventions are hypothesized to ameliorate motor and cognitive deficits in older adults. Especially, video game-based physical exercise might have the potential to train motor in combination with cognitive abilities in older adults (2-4). The aim of this study was to compare the effects of conventional balance training and video game-based physical exercise, a so-called exergame, on executive functions (EFs) and gait performance. We hypothesized that a combined motor and cognitive training would differently effect on EFs and spatio-temporal gait parameters when compared to more conventional motor training.

Methods

Twenty-seven participants (mean age 79.2 ± 7.3 years) were randomly assigned to either an exergame or balance training group. All participants completed 24 training sessions including three 30min sessions/week. Before and after the intervention, EFs were measured using sub-tests of the Test for Attentional Performance test battery. Moreover, spatio-temporal gait parameters were recorded during single- and dual-task walking conditions using the Physilog system. The time × group interaction effect was analysed using Puri and Sen L Statistics for ranked data. Furthermore, differences in time (within groups) were performed using the Wilcoxon Signed Rank Test.

Results

No significant interaction effects were found for EFs and gait parameters. Comparing pre- vs. post-test, EFs improved both within the exergame and within the balance group ($p < 0.05$). Moreover, spatio-temporal gait parameters primarily improved within the exergame group under dual-task conditions and within the balance group under single-task conditions, respectively ($p < 0.05$).

Discussion/Conclusion

These results indicate that both exergame and balance training positively affect prefrontal cortex-located cognitive and motor functions, however, in varying proportion. For aging humans, such exercise programs that effectively improve prefrontal cortex functioning, especially EFs and gait performance, might be important since age-associated reduction of EFs can impact gait and amplify the risk of falling (5).

References

1. Rosano, C., Studenski, S. A., Aizenstein, H. J., Boudreau, R. M., Longstreth, W. T., & Newman, A. B. (2011). Slower gait, slower information processing and smaller prefrontal area in older adults. _Age and Ageing, 41_(1), 58-64. doi:10.1093/ageing/afr113

2. Green, C. S., & Bavelier, D. (2008). Exercising your brain: A review of human brain plasticity and training-induced learning. _Psychology and Aging, 23_(4), 692-701. doi:10.1037/a001434

3. Pichierri, G., Wolf, P., Murer, K., & Bruin, E. D. (2011). Cognitive and cognitive-motor interventions affecting physical functioning: A systematic review. _BMC Geriatrics, 11_(1). doi:10.1186/1471-2318-11-29

4. Schättin, A., Arner, R., Gennaro F., de Bruin, E. D. (2016). Adaptations of prefrontal brain activity, executive functions, and gait in healthy elderly following exergame and balance training: A randomized-controlled study. _Frontiers in aging neuroscience, 8(278)._ doi: 10.3389/fnagi.2016.00278

5. Mirelman, A., Herman, T., Brozgol, M., Dorfman, M., Sprecher, E., Schweiger, A., Hausdorff, J. M. (2012). Executive Function and Falls in Older Adults: New Findings from a Five-Year Prospective Study Link Fall Risk to Cognition. _PLoS ONE, 7_(6). doi:10.1371/journal.pone.0040297

113

Title

Physical activity and adolescent's creativity: Feedback matters!

Authors/Affiliation

Mirko Schmidt[1], Valentin Benzing[1]
[1]_Institute of Sport Science, University of Bern, Bern, Switzerland_

Abstract

Introduction

Concentration and creativity are two key prerequisites for learning at school. Whereas the first is thought to be relevant for continuous cognitive tasks, the second receives its relevance in more complex tasks, such as, for example, generating new solutions in novel tasks. Therefore, theorists as well as practitioners are interested in which factors may lead to enhanced concentration and creativity. Whereas concentration can be enhanced by acute physical activity of moderate intensity (McMorris & Hale, 2015), especially positive feedback can be used to induce positive affect, which in turn is related to creative thinking (Byron & Khazanchi, 2012). The aim of the present study was therefore to disentangle the separate and/or combined effects of physical activity and positive feedback induced by four different interventions on adolescent's concentration and creativity.

Methods

Using a 2 × 2 between-subjects experimental design, 104 adolescents between the ages of 15 and 19 years ($M = 16.99$, $SD = 0.90$) were randomly assigned to one of four experimental conditions: (1) EXPO = exercise with positive feedback, (2) EXNE = exercise with negative feedback, (3) SEPO = sedentary with positive feedback, and (4) SENE = sedentary with negative feedback. Adolescent's concentration, i.e. "number connection test" (Zahlenverbindungstest, ZVT; Oswald & Roth, 1987), and their creativity, i.e. German version of the Remote Associates Test (RAT; Mednick & Mednick, 1967) were measured before and immediately after a 15-minute intervention.

Results

Manipulation check analyses, by means of 2 x 2 ANOVAs, revealed significant differences in heart rates and changes in positive affect. Higher heart rates ($F(1, 102) = 231.61$, $p < .0005$, $\eta^2_p = .694$) as well as higher levels in positive affect ($F(1, 102) = 12.71$, $p = .001$, $\eta^2_p = .111$) were observed in the two exercise (EXPO, EXNE) and in the two conditions with positive feedback (EXPO, SEPO), respectively. Concerning the main analyses, ANCOVAs (with pre measures as covariates and gender as an additional factor) revealed that physical exertion was the factor being responsible for faster information processing in the ZVT ($F(8, 95) = 14.76$, $p < .0005$, $\eta^2_p = .134$). For creativity, no significant main effect could be found. However, a significant interaction of these two factors suggests a domain specific influence of positive vs. negative performance feedback on adolescent's convergent thinking ($F(8, 95) = 4.70$, $p = .033$, $\eta^2_p = .047$). Gender specific analyses indicate a more pronounced improvement in creativity for girls ($F(8, 95) = 13.70$, $p < .0005$, $\eta^2_p = .121$).

Discussion/Conclusion

Whereas concentration can be enhanced through an acute bout of moderate intensity exercise, creativity seems to be resistant to this effect. However, the detected interaction effect points on setting-specific impacts of positive and negative feedback. Whereas physical activity has to be accompanied by negative feedback, in a sedentary condition feedback has to be positive to foster enhanced creative performance. Moreover, girls seem to be more malleable concerning their creativity.

References

Byron, K., & Khazanchi, S. (2012). Rewards and creative performance: a meta-analytic test of theoretically derived hypotheses. _Psychological Bulletin, 138_(4), 809–830.

McMorris, T., & Hale, B. J. (2015). Is there an acute exercise-induced physiological/biochemical threshold which triggers increased speed of cognitive functioning? A meta-analytic investigation. _Journal of Sport and Health Science, 4_(1), 4–13.

Mednick, S. A., & Mednick, M. T. (1967). _Examiner's manual, Remote Associates Test: College and adult forms 1 and 2_. Boston: Houghton Mifflin

114

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Exercise and Cognition in Adolescents and Older Adults

Oswald, W. D., & Roth, E. (1987). *Der Zahlen-Verbindungstest (ZVT) [Number connection test]*. Göttingen: Hogrefe.

Sport and Health – Intervention in patients

Title

Asthma and Exercise –Mechanisms of Short- and Long-Term Effects

Authors/Affiliation

Philipp Eichenberger[1], Christina Spengler[1,2]
[1]Exercise Physiology Lab, Institute of Human Movement Sciences and Sport, ETH Zurich, Switzerland;
[2]Zurich Center for Integrative Human Physiology (ZIHP), University of Zurich, Switzerland

Abstract

Although there is unequivocal agreement that physical exercise training is beneficial in patients with asthma due to improvements in cardio-pulmonary fitness and quality of life (QoL), it remains unclear whether these improvements are related to changes in asthma-specific pathophysiological features, i.e. reduced airway inflammation, bronchial hyperresponsiveness (BHR) and airway remodeling. In a systematic review and meta-analysis we recently provided evidence that improvements in cardio-pulmonary fitness and QoL are partly associated with reductions in BHR and increases in lung function (Eichenberger et al., 2013). These studies also suggest, although less consistently, positive effects of exercise training on airway inflammation and the need for asthma medication.

Besides the potential of muscular work during exercise contributing to a decrease in local airway inflammation (Scott et al., 2015), mechanical stretch applied to the airways was also shown to lower BHR (Busk et al., 2013). Given that during exercise ventilation airways are repetitively stretched, a modality with higher levels of ventilation using isolated, volitional hyperpnea (HYP) might be similarly or more effective on the airways. Indeed, we were able to demonstrate that mild-moderate asthmatics can safely perform 30 min of continuous HYP with partial rebreathing of expired air (at 60% of maximal voluntary ventilation), with changes in airway resistance and lung function similar to healthy controls, small in magnitude and quickly resolved. A subsequent pilot study showed that HYP-training over a period of 2.5 months leads to significantly decreased BHR (mannitol challenge) with larger changes in subjects with greater initial BHR, and to a reduction in airway inflammation (exhaled nitric oxide).

Since , HYP-training has been shown to slightly reduce dyspnea during daily activities in patients with COPD, a change in perception that might impose a risk for asthmatics as the severity of an asthma exacerbation might be underestimated, it was important that we found perception of bronchoconstriction to remain unchanged, even after the 2.5-month HYP-training phase.

Despite the known beneficial effects of exercise training in asthma, many asthmatics still fail to undertake sufficient exercise, which can be partly attributed to the fear of inducing asthma symptoms in the context of exercise-induced bronchoconstriction (EIB). Although EIB was shown to be attenuated by intense, pre-exercise warm-up (Stickland et al., 2012), warm-up itself can also induce EIB and potentially limit effective exercise participation. In this context, a recent study showed that a 10-min HYP warm-up (without inducing EIB) significantly attenuated EIB in an exercise challenge and improved its recovery to a similar extent as previously reported for whole-body warm-up (Eichenberger et al., 2016).

116

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Sport and Health – Intervention in patients

In conclusion, repetitive airway stretch might be one of the mechanisms of exercise-mediated benefits on BHR and possibly also on airway inflammation. Thus HYP may be used as a separate or adjunct to exercise training for asthma management – together with (possibly reduced) medication.

References

Busk, M., Busk, N., Puntenney, P., Hutchins, J., Yu, Z., Gunst, S. J., & Tepper, R. S. (2013). Use of continuous positive airway pressure reduces airway reactivity in adults with asthma. *European Respiratory Journal, 41*(2), 317-322.

Eichenberger, P. A., Diener, S. N., Kofmehl, R., & Spengler, C. M. (2013). Effects of exercise training on airway hyperreactivity in asthma: a systematic review and meta-analysis. *Sports Medicine, 43*(11), 1157-1170.

Eichenberger, P. A., Scherer, T. A., & Spengler, C. M. (2016). Pre-Exercise Hyperpnea Attenuates Exercise-Induced Bronchoconstriction Without Affecting Performance. *PLoS ONE, 11*(11), doi: 10.1371/journal.pone.0167318.

Scott, H. A., Latham, J. R., Callister, R., Pretto, J. J., Baines, K., Saltos, N., Upham, J. W., & Wood, L. G. (2015). Acute exercise is associated with reduced exhaled nitric oxide in physically inactive adults with asthma. *Annals of Allergy, Asthma, and Immunology, 114*(6), 470-479.

Stickland, M. K., Rowe, B. H., Spooner, C. H., Vandermeer, B., & Dryden, D. M. (2012). Effect of warm-up exercise on exercise-induced bronchoconstriction. *Medicine and Science in Sports and Exercise, 44*(3), 383-391.

Sport and Health – Intervention in patients

Title

Do physical fitness and activity influence indices of arterial stiffness in mild to moderate rheumatic disease?

Authors/Affiliation

[1]Marcin Thimo, [1]Deiseroth Arne, [1,2]Schäfer Juliane, [1]Berger Colette, [3]Bannert Bettina, [1]Schmidt-Trucksäss Arno, [3]Kyburz Diego, [1]Hanssen Henner

[1]Department of Sport, Exercise and Health, Div. of Sports and Exercise Medicine, University of Basel, Switzerland
[2]Basel Institute for Clinical Epidemiology and Biostatistics, University Hospital Basel, Switzerland
[3]Department of Rheumatology, University Hospital Basel, Switzerland

Abstract

Introduction

Patients with rheumatic diseases have an increased risk of cardiovascular (CV) comorbidity and mortality. Indices of arterial stiffness are vascular biomarkers for CV risk and exercise has been shown to improve arterial stiffness. The aim of this study therefore was to investigate the association of cardiorespiratory fitness (CRF) with arterial stiffness in patients with rheumatic diseases.

Methods

A cross-sectional study was conducted on patients with rheumatic diseases, where pulse wave velocity (PWV), augmentation index standardized to a heart rate of 75 bpm (Aix@75) and central pulse pressure (cPP) were determined as indices of arterial stiffness. CRF was measured as peak oxygen consumption (VO2peak). Multivariable regression analysis was used to assess the influence of VO2peak on arterial stiffness indices adjusted for age and sex.

Results

Twenty-eight patients (14 female) with a median age of 51 (interquartile range 45, 57) years were included. On average, Aix@75 decreased by -1.6% (95% confidence interval (CI) -2.9, -0.3) for every one metabolic equivalent (1 MET = 3.5 ml/kg/min) increase in VO2peak. There was no apparent effect of VO2peak on PWV and cPP with an expected change of -0.1 m/s (95% CI -0.3; 0.1) for PWV and -0.4 mmHg (95% CI -1.7; 0.9) for cPP, both for every one MET increase in VO2peak.

Discussion/Conclusion

Our data suggest an inverse relationship between CRF and arterial stiffness in patients with rheumatic diseases. Higher CRF seems to primarily influence global Aix@75 rather than central PWV. At early stages of rheumatic diseases, exercise may primarily affect peripheral arteries.

118

Sport and Health – Intervention in patients

Title

Auswirkungen einer bariatrischen Operation auf die Gefäßgesundheit bei Adipositas

Authors/Affiliation

[1]*Streese Lukas.,* [1]*Bühler Corsin.,* [1]*Zumthor Stefan.,* [1]*Schmidt-Trucksäss Arno.,* [2]*Peters Thomas.,* [1]*Hanssen Henner*

[1]*Departement für Sport, Bewegung und Gesundheit, Bereich Präventive Sportmedizin & Systemphysiologie, Universität Basel, Schweiz*

[1]*Innere Medizin, Endokrinologie und Ernährungszentrum, St. Claraspital, Basel, Schweiz*

Abstract

Introduction

Adipositas erreicht in westlichen Ländern das Ausmaß einer Pandemie. Für Patienten mit Adipositas permagna stellt die bariatrische Operation (BOP) häufig die letzte Möglichkeit dar, um die begleitenden Komorbiditäten zu minimieren. Die Wirkung einer BOP auf das Gefässsystem ist bislang kaum untersucht. In dieser Studie wird die Auswirkung einer BOP auf die retinalen Gefässdurchmesser als mikrovaskulärer Biomarker für das kardiovaskuläre Risiko und die arterielle Gefässsteifigkeit untersucht.

Methods

15 Personen mit ausgeprägter Adipositas (BMI 43,65±4,04 kg/m2) im Alter von 22 bis 61 Jahren (Alter 43,63±12,39 Jahre) wurden prä- und postoperativ (Magenbypass) untersucht. Die arterielle Gefäßsteifigkeit wurde anhand des Cardio Ankle Vascular Index (CAVI) und des Augmentationsindexes (Alx) berechnet. Die Analyse der retinalen Mikrozirkulation erfolgte durch den Static Vessel Analyzer (SVA-T). Es wurden zwei digitale Funduskopien zur Berechnung der zentralen retinalen Arteriolen- und Venenäquivalente (CRAE/CRVE) und deren Verhältnis (AVR) erstellt und gemittelt.

Results

Die Probanden haben durch die BOP durchschnittlich 13,0±3,3kg abgenommen, der BMI verbesserte sich um 4,5±0,9kg/m^2 und der mittlere systolische Blutdruck senkte sich um 12±9mmHg. Die Analysen der Daten des CAVI (p=0,972) und des Alx@75 (p=0,492) zeigten keine signifikanten Unterschiede zwischen den beiden Messzeitpunkten. Bei der Analyse der Daten der retinalen Mikrozirkulation zeigte sich, dass sich das CRAE im Mittel um 8,06±5,86µm prä (180,05±17,05µm) zu post-OP (188,11±17,45µm) signifikant (p≤0,001) verbesserte. Bei der AVR kam es ebenfalls zu einer signifikanten Verbesserung (p=.001) von -0,03±0,02µm zwischen der Prä- (0,83±0,06µm) und der Postmessung (0,86±0,05µm).

Discussion/Conclusion

Durch die BOP kommt es sechs Wochen nach Operation zu signifikanten Verbesserungen klassischer kardiovaskulärer Risikofaktoren. Auf mikrovaskulärer Ebene konnte mit der Weitstellung der retinalen Arterien postoperativ eine Verbesserung subklinischer Atherosklerose nachgewiesen werden. Die retinalen Gefäßdurchmesser scheinen ein valider und sensitiver Biomarker für das kardiovaskuläre Risiko bei ausgeprägter Adipositas zu sein. Mit dieser Methode können kurzfristige Therapieverläufe nach BOP differenziert werden.

Physical activity and health in children

Title

Prevalence and influence of obesity and hypertension on arterial stiffness in Swiss primary school children: The ExAMIN Youth study

Authors/Affiliation

Sabrina Köchli[1], Katharina Endes[1], Monique Nussbaumer[1], Lukas Zahner[1], Arno-Schmidt-Trucksäss[1], Henner Hanssen[1]

[1]Department of Sport, Exercise and Health, Div. of Sports and Exercise Medicine, University of Basel, Switzerland

Abstract

Introduction

Obesity and hypertension have been shown to impair central arterial stiffness in adults and exercise is known for its potential to improve vascular function. However, it is not clear whether and to what extent arterial stiffness is affected by body mass index (BMI), high blood pressure (BP) and cardiorespiratory fitness (CRF) early in life.

Methods

In this cross-sectional study, 542 primary school children (aged 7.4±0.4years) were screened for pulse wave velocity (PWV; oscillometric device), BP (AHA guidelines), BMI and CRF (20m shuttle run performance) by standardised procedures. BP was categorised according to the reference values of the population-based German KiGGS study. Group comparisons were performed using univariate analysis of variance (ANOVA).

Results

In our cohort, 86% were normal weight (n=468), 11% were overweight (n=58) and only 3% (n=16) were obese. Based on systolic BP, 77% were classified as normotensive (n=414), 9% as prehypertensive (n=50) and 14% as hypertensive (n=78). Overweight children (PWV: 4.58±0.30m/s) and obese children (4.75±0.31m/s) had higher arterial stiffness compared to normal weight children (4.39±0.29m/s) (p<0.001). Young children categorised as prehypertensive (PWV: 4.54±0.28m/s) and hypertensive (4.65±0.32m/s) showed higher arterial stiffness compared to normotensive peers (4.37±0.29m/s) (p<0.001). CRF was not associated with central PWV in this cohort of children. **Discussion/Conclusion**

BMI and blood pressure, even at the level of overweight and prehypertension, are already associated with increased arterial stiffness in young children aged 6-8 years. Vascular impairments can be detected very early in life and timely initiation of screening and treatment strategies need to be implemented to counteract the increasing burden of vascular disease in adulthood.

120

Title

Acute effects of moderate aerobic and coordinative exercise on neurocognitive indices of inhibitory control in children with ADHD

Authors/Affiliation

Sebastian Ludyga[1], Serge Brand[1,2], Markus Gerber[1], Uwe Pühse[1]

[1]Department of Sport, Exercise and Health, Sport Science Section, University of Basel; [2]Psychiatric Clinics of the University of Basel, Center for Affective, Stress and Sleep Disorders

Abstract

Introduction

Varying levels of inattention, impulsivity and hyperactivity characterize children with attention-deficit hyperactivity disorder (ADHD). These symptoms are accompanied by deficits in executive functions and inhibitory control in particular (Willcutt et al., 2005). Whereas evidence suggests that acute aerobic exercise elicits temporary improvements in this cognitive domain (Ludyga et al., 2016), effects of coordinative exercise have not been investigated in children with ADHD. Therefore, the present study aimed to compare the acute effects of coordinative and aerobic exercise on neurophysiological correlates of inhibitory control.

Methods

Eighteen children with ADHD-combined type (age: 12.8 ± 1.8 years; BMI: 20.8 ± 5.0 kg·m^{-2}) were recruited from local paediatricians. Conners 3 scales (parent and self-reporting) were used to verify that the diagnostic criteria of the ICD-10 were fulfilled. Using a cross-over design, participants completed 20 min of moderate aerobic exercise, coordinative exercise or an inactive control condition (watching a video while seated) on three separate days. Prior to and after each session, inhibitory control was assessed using a computer-based version of the Flanker task. During the task, event-related brain potentials were recorded using electroencephalography (128 electrodes located according to 10:10 system). As neurophysiological indices of cognitive control amplitude and latency of the N200 and P300 components were assessed.

Results

Statistical analysis revealed an interaction of time and condition, showing that exercise compared to the control condition decreased reaction time in both congruent and incongruent trials. This reduction was more pronounced for aerobic exercise than coordinative exercise. Concerning event-related potentials, there was an interaction of time and condition, indicating an increase of the P300 amplitude after exercise. Compared with coordinative exercise, the aerobic exercise session elicited a higher increase of the P300 amplitude with peak values obtained at Pz position.

Discussion/Conclusion

Our findings suggest that in children with ADHD an acute bout of moderately-intense aerobic exercise elicits greater improvements on speed of processing and inhibitory control than a coordinative exercise session. The facilitation of the P300 amplitude further indicates that this is due to an increased allocation of attentional resources towards the task. Therefore, children with ADHD are encouraged to engage in moderate aerobic exercise to prepare for a situation demanding high inhibitory control.

References

Ludyga, S., Gerber, M., Brand, S., Holsboer-Trachsler, E., & Pühse, U. (2016). Acute effects of moderate aerobic exercise on specific aspects of executive function in different age and fitness groups: A meta-analysis. *Psychophysiology*, *53* (11), 1611–1626. doi:10.1111/psyp.12736

Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the Executive Function Theory of Attention-Deficit/Hyperactivity Disorder: A Meta-Analytic Review. *Biological Psychiatry*, *57*(11), 1336–1346. doi:10.1016/j.biopsych.2005.02.006

Physical activity and health in children

Title

Influence of physical activity on cognitive performance and brain oxygenation in children aged 10-11 years

Authors/Affiliation

Manuel Mücke[1], Christian Andrä[2], Markus Gerber[1], Uwe Pühse[1], Sebastian Ludyga[1]

[1]_Departement of Sport, Exercise and Health, University of Basel, Basel, Switzerland_

[2]_Faculty of Sport Science, University of Leipzig, Leipzig, Germany_

Abstract

Introduction

Studies have shown that high physical activity (PA) in childhood can have a positive influence on higher cognitive functions and academic achievement and might enhance brain development (Donnelly et al., 2016; Hillman, Erickson, & Kramer, 2008). By contrast, studies using objective measures for PA partly showed negative effects on academic performance (Esteban-Cornejo et al., 2014). Furthermore, there is no consensus on how blood oxygenation in task relevant brain areas during cognitive tasks is influenced by PA habits. The objective of this study was to examine the influence of objectively measured everyday PA on childrens' cognitive performance and blood oxygenation in the prefrontal cortex during cognitive tasks.

Methods

55 children (age: 10-11 years) attending the 5th classes of 2 German high schools performed a phonetic verbal fluency test (VFT) and a mental arithmetic task (MA) to assess cognitive flexibility and working memory capacity, respectively. Changes in cerebral blood oxygenation from a 2 min resting period to cognitive tasks were measured using functional near infrared spectroscopy (fNIRS) across the prefrontal cortex. Moderate to vigorous physical activity (MVPA) was recorded with actigraphy over the course of one week. For statistical analyses, a median split was performed to differentiate between children with higher (Mean (SD): 1334 (203) min/week) and lower MVPA (Mean (SD): 778 (219) min/week). Using MANOVA, cognitive performance (correct answers on VFT and MAT) was compared between groups. Additionally, possible differences in cerebral blood oxygenation during cognitive tasks were examined using statistical parametric mapping.

Results

Controlling for sex, children with higher MVPA had more correct answers on MA than children with lower MVPA ($F(1, 51)=7.849$, $p=0.007$, $\eta_p^2=0.133$). In contrast, no group differences were observed for the VFT ($F(1, 51)=0.235$, $p=0.648$, $\eta_p^2=0.004$). Additionally, statistical parametric mapping revealed no differences in prefrontal cortex blood oxygenation between children with lower and higher MVPA during both cognitive tasks.

Discussion/Conclusion

Our results indicate that MVPA has an impact on working memory. This effect is more pronounced in girls compared to boys, probably due to a ceiling effect of MA performance in boys. Furthermore, benefits of MVPA for working memory are not related to specific changes in cortical activation patterns within the prefrontal cortex.

References

Donnelly, J. E., Hillman, C. H., Castelli, D., Etnier, J. L., Lee, S., Tomporowski, P., Lambourne, K. & Szabo-Reed, A. N. (2016). Physical Activity, Fitness, Cognitive Function, and Academic Achievement in Children: A Systematic Review. _Medicine and science in sports and exercise_, _48_(6), 1197–1222.

Esteban-Cornejo, I., Tejero-Gonzalez, C. M., Martinez-Gomez, D., Cabanas-Sanchez, V., Fernandez-Santos, J. R., Conde-Caveda, J.,. . . Veiga, O. L. (2014). Objectively measured physical activity has a negative but weak association with academic performance in children and adolescents. _Acta paediatrica (Oslo, Norway : 1992)_, _103_(11), e501-6.

Hillman, C. H., Erickson, K. I., & Kramer, A. F. (2008). Be smart, exercise your heart: exercise effects on brain and cognition. _Nature reviews. Neuroscience_, _9_(1), 58–65.

Title

Chronic hypoxia and loss of muscle mass: a matter of hypoxic dose?

Authors/Affiliation

Gommaar D'Hulst[1], David Bishop[2], Louise Deldicque[3] and Katrien De Bock[1]

[1] Department Health Sciences and Technology, Laboratory of Exercise and Health, Swiss Federal Institute of Technology (ETH) Zurich, Zurich, Switzerland
[2] Institute of Sport and Active Living (ISEAL), Victoria University, Melbourne, Australia
[3] Institute of Neuroscience, Université catholique de Louvain, Louvain-la-Neuve, Belgium

Abstract

Introduction

Skeletal muscle wasting has been shown to be a mechanism by which humans are able to adapt to extreme altitude. The molecular mechanisms underlying this phenomenon are not well understood, likely due to different hypoxic doses (altitude x time spent at altitude) used in various studies. In this study we use a well-controlled experimental setup in order to determine molecular markers involved in de novo protein synthesis and breakdown in human skeletal muscle after a long-term hypoxic exposure. Furthermore, based on this data and previous literature, we propose a model which linearly relates hypoxic dose with percentage loss in muscle mass.

Methods

Eight young male subjects lived in a normobaric hypoxic hotel (FiO2 14.1%, 3200 m) for 15 days in well controlled conditions for nutrition and physical activity. Skeletal muscle biopsies were obtained in the *m. vastus lateralis* before (PRE) and immediately after (POST) hypoxic exposure. The hypoxic dose model was based on 9 studies with the following inclusion criteria: search terms "hypoxia", "altitude", "expedition", "human muscle", "cross sectional area". The articles were reviewed to identify those that used long-term (simulated) hypoxia (>2 weeks, >3000m), had hypoxic dose sufficiently explained in the methods and had a measurement of CSA as indication of skeletal muscle fiber atrophy.

Results

Intramuscular HIF-1α protein expression decreased (-49%, p=0.03), whereas HIF-2α was unaffected from PRE to POST hypoxic exposure. Downstream HIF-1α target genes VEGF-A (-66%, p=0.006) and BNIP3 (-24%, p=0.002) were down-regulated as well and a tendency was measured for Nedd4 (-47%, p=0.07), suggesting lowered HIF-1α transcriptional activity after 15-d exposure to environmental hypoxia. No difference was found on LC3bII/I ratio and p62 protein expression tended to increase (+45%, p=0.07) compared to PRE exposure levels, suggesting that autophagy was only marginally modulated after chronic hypoxia. The mTORC1 pathway was not altered as Akt, mTOR, S6K1 and 4EBP1 phosphorylation did not change between PRE and POST. Finally, myofiber CSA was unchanged between PRE and POST.

Clearly, 15 days of moderate altitude was insufficient to induce significant changes in intramuscular signaling or CSA. A possible explanation for this is the relatively low hypoxic dose: Fig. 1 shows a significant negative correlation (r=-0.69, p<0.02) between hypoxic dose and percentage decrease in muscle fiber area based on 9 previous reports. Furthermore, as Fig. 1 shows, the threshold of hypoxic dose above which skeletal muscle atrophy is initiated would be situated around 5000 km·h. As such, this threshold was not exceeded in the study presented here.

Discussion/Conclusion

Skeletal muscle is a highly hypoxia-resistant tissue, consequently, 15-days of moderate hypoxia only marginally altered intramuscular signaling related to protein synthesis/breakdown. A further review of literature revealed a critical threshold above which skeletal muscle wasting could be initiated at altitude (Fig. 1). Future human time-course studies in hypoxia in combination with intramuscular PO2 measurements should provide more insight in how and when the hypoxic stimulus is severe enough to elicit skeletal muscle atrophy.

123
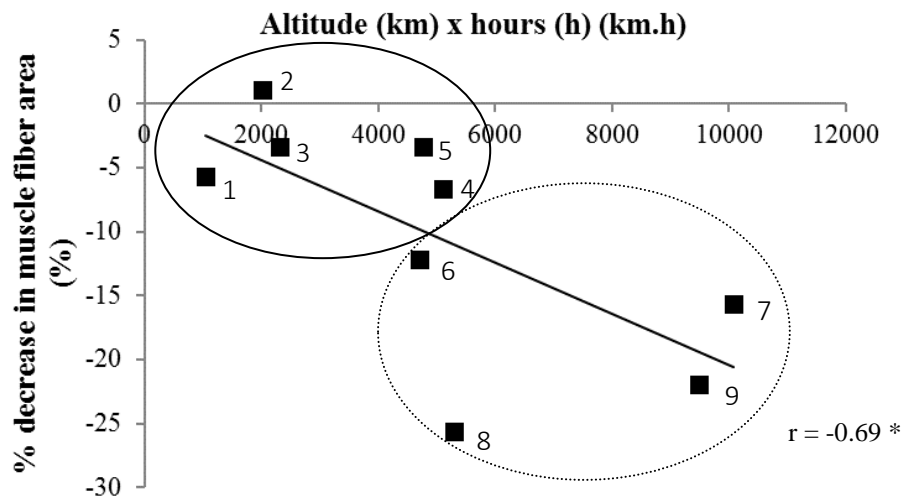
Fig. 1. *Effect of altitude and exposure time on % decrease in muscle mass in humans.* Relation between hypoxic dose and decrease in CSA for NEG studies, showing no effect (full circle) and POS studies, showing an effect of long-term hypoxia on muscle mass loss (dashed circle). *$p=0.02$ vs. NEG studies. The reference to the respective study can be found next to each data point.

1. D'Hulst, G. *et al.* Fifteen days of 3,200 m simulated hypoxia marginally regulates markers for protein synthesis and degradation in human skeletal muscle. *Hypoxia* 1–14 (2016).

2. Green, H. *et al.* Downregulation in muscle Na(+)-K(+)-ATPase following a 21-day expedition to 6,194 m. *J. Appl. Physiol* **88,** 634–640 (2000).

3. Jacobs, R. a. *et al.* Twenty-eight days of exposure to 3,454 m increases mitochondrial volume density in human skeletal muscle. *J. Physiol.* **5,** 1151–1166 (2015).

4. Lundby, C. *et al.* Acclimatization to 4100 m does not change capillary density or mRNA expression of potential angiogenesis regulatory factors in human skeletal muscle. *J. Exp. Biol* **207,** 3865–3871 (2004).

5. Levett, D. *et al.* Acclimatization of skeletal muscle mitochondria to high-altitude hypoxia during an ascent of Everest. *FASEB J* **26,** 1431–1441 (2012).

6. Boutellier, U., Howald, H., di Prampero, P. E., Giezendanner, D. & Cerretelli, P. Human muscle adaptations to chronic hypoxia. *Prog. Clin. Biol. Res.* **136,** 273—285 (1983).

7. Mizuno, M., Savard, G. K., Areskog, N. H., Lundby, C. & Saltin, B. Skeletal muscle adaptations to prolonged exposure to extreme altitude: a role of physical activity? *High Alt. Med. Biol* **9,** 311–317 (2008).

8. MacDougall, J. D. *et al.* Operation Everest II : structural adaptations in skeletal muscle in response to extreme simulated altitude. *Acta Physiol Scand* **142,** 421–427 (1991).

9. Hoppeler, H. *et al.* Morphological adaptations of human skeletal muscle to chronic hypoxia. *Int. J. Sport. Med* **11 Suppl 1,** S3–S9 (1990).

Title

Relationship between initial hemoglobin mass and hemoglobin mass increase following live high – train low in athletes

Authors/Affiliation

Anna Hauser[1,2], Severin Troesch[1], Tom Steiner[1], Franck Brocherie[3], Olivier Girard[4], Laurent Schmitt[5], Grégoire P. Millet[2*] and Jon P. Wehrlin[1*]

[1]_Swiss Federal Institute of Sport, Section for Elite Sport, Magglingen, Switzerland_

[2]_ISSUL, Institute of Sport Sciences, Department of Physiology, Faculty of Biology and Medicine, University of Lausanne, Switzerland_

[3]_INSEP, Institut National du Sport, de l'Expertise et de la Performance, Paris, France_

[4]_ASPETAR, Qatar Orthopaedic and Sports Medicine Hospital, Athlete Health and Performance Research Centre, Doha, Qatar._

[5]_National School of Mountain Sports/National Ski-Nordic Centre, Prémanon, France_

Abstract

Introduction

Considerable individual variation in hemoglobin mass (Hb_{mass}) response to altitude training in athletes has been reported (Friedmann et al., 2005; Hauser et al., 2016). One reason that might explain individual Hb_{mass} responsiveness to altitude training could be an individual's baseline Hb_{mass} level, assuming that athletes with already high initial Hb_{mass} have a limited ability to further increase their Hb_{mass} following altitude training (Robach et al., 2012). Since altitude training is primarily used by elite endurance athletes who have already elevated Hb_{mass} values, the hypothesis that athletes starting with high initial Hb_{mass} may not further increase their Hb_{mass} following LHTL needs to be tested. Thus, the aim of the present study was to examine the relationship between initial Hb_{mass} and Hb_{mass} increase following live high – train low (LHTL) altitude training in male endurance and team sport athletes.

Methods

Overall 58 male athletes (35 well-trained endurance athletes and 23 elite male field hockey players) performed a LHTL training camp (200-230 h) under normobaric or hypobaric hypoxic conditions. Hb_{mass} was measured in duplicate always pre- and post- LHTL with the optimized CO-rebreathing method (Schmidt et al., 2005).

Results

There was a trivial relationship (r = -0.02, P = 0.9) between absolute initial Hb_{mass} and percent Hb_{mass} increase. A moderate relationship (r = 0.3, P = 0.02) between relative Hb_{mass} and percent Hb_{mass} increase was detected. Mean absolute and relative Hb_{mass} increased to similar extent in endurance athletes (916 ± 88 g to 951 ± 96 g, 3.8 ± 2.9%, _P_ < 0.001 and 13.1 ± 1.2 g/kg to 13.6 ± 1.1 g/kg, 4.1 ± 4.2%, _P_ < 0.001) and team sport athletes (920 ± 120 g to 957± 127 g, 4.0 ± 2.9%, _P_ < 0.001 and 11.9 ± 0.9 g/kg to 12.3 ± 0.9 g/kg, 4.0 ± 3.2%, _P_ < 0.001) following LHTL.

Discussion/Conclusion

The trivial and moderate relationship between initial Hb_{mass} and Hb_{mass} increase following LHTL in team sport and endurance athletes, indicates that even athletes with already high initial Hb_{mass} can benefit from LHTL training for further Hb_{mass} improvement. Further, it seems that half of the effect was likely due to the statistical phenomenon "regression towards the mean".

References

Friedmann, B., Frese, F., Menold, E., Kauper, F., Jost, J., & Bartsch, P. (2005). Individual variation in the erythropoietic response to altitude training in elite junior swimmers. _Br J Sports Med, 39_(3), 148-153.

Hauser, A., Schmitt, L., Troesch, S., Saugy, J. J., Cejuela-Anta, R., Faiss, R., Robinson, N., Wehrlin, J. P., & Millet, G. P. (2016). Similar Hemoglobin Mass Response in Hypobaric and Normobaric Hypoxia in Athletes. _Med Sci Sports Exerc, 48_(4), 734-741.

Robach, P., & Lundby, C. (2012). Is live high-train low altitude training relevant for elite athletes with already high total hemoglobin mass? _Scand J Med Sci Sports, 22_(3), 303-305.

Training and Coaching 2

Schmidt, W., & Prommer, N. (2005). The optimised CO-rebreathing method: a new tool to determine total haemoglobin mass routinely. *Eur J Appl Physiol, 95*(5-6), 486-495.

Training and Coaching 2

Authors/Affiliation

Lilian Roos[1,2], Klaus Michael Frei[1], Thomas Wyss[1]

[1]Swiss Federal Institute of Sport Magglingen SFISM, Magglingen, Switzerland; [2]Department of Medicine, Movement and Sport Science, University of Fribourg, Fribourg, Switzerland

Abstract

Introduction

In a recently conducted focus group with 22 coaches of elite endurance athletes, the coaches were asked to rate the most important methods to assess their athletes' external or internal training load. The session rating of perceived exertion (sRPE) was named by 91% of participants, further 63% of the interviewed coaches reported to use sRPE during daily training (Roos, Taube, Brandt, Heyer, & Wyss, 2013). However, little is known about factors that potentially influence the repeated and optimal assessment of sRPE. Thus, the aim of this study was to identify the factors which influence the assessment of sRPE after running training sessions.

Methods

Forty recreational and competitive endurance athletes (28 men, 12 women; age 31.3±9.5 years) were recruited to perform four blocks of five running training sessions. For every block, the time point to report sRPE after training cessation was randomly assigned. The four time points were directly after training cessation, 30 minutes after training cessation, in the evening of the same day before going to bed, or the next morning directly after waking up. An online questionnaire was used to answer the question "How hard was your training today?" on the RPE scale (Foster et al., 2001). When answering the RPE question, the athletes further had to describe the content of the training session (e.g. long jog, regenerative run, slow run, speedy run, fast run, hill run, or interval training) or hand in a copy of their training diary. The athletes were allowed to train according to their individual training programs while wearing a heart rate monitor and had no restrictions concerning training type or content. The duration of a training session was multiplied with the reported RPE value, which resulted in the sRPE. The time passed between training cessation and answering the questionnaire was calculated to the minute and used to group the training sessions into four categories: time point 1 = 0–30 minutes, time point 2 = 31–180 minutes, time point 3 = 181–720 minutes, time point 4 = more than 720 minutes passed since training cessation. The HR data of each individual training session was used to calculate the training impulse according to Edwards (1993; HR-TRIMP). The maximal heart rate (HRmax) was determined by an individual maximal performance test. To compute HR-TRIMP, five HR zones were defined ranking from 1=50%–60% HRmax to 5=90%–100% HRmax. The duration in minutes in each HR zone was multiplied with its corresponding factor (1 to 5) and summed to obtain the total training load for each training session.

Statistical analyses were performed with IBM SPSS Statistics 22 (IBM Corporation, Armonk NY, USA) and SAS 9.4 (SAS Institute Inc, Cary NC, USA). Data are shown as mean ± standard deviation (SD). The alpha level was set at p=.05. A Generalized Linear Mixed Model with repeated measures was computed. The sRPE was modeled in a hierarchical function of subjects' training sessions and time point of sRPE assessment. Fixed effects were HR-TRIMP, training type, time point of sRPE assessment, gender, fitness level, weekly training hours, running experience, and the interactions between time point, HR-TRIMP, and training type. Random effects were the random intercept, training type, time point of sRPE assessment, and cross-level interaction "time point x training type". To simplify and visualize the effects of the identified predictors on sRPE, linear regressions with sRPE as the dependent variable and HR-TRIMP as the independent variable were performed. The regression slopes were tested for significant differences by administering a global Chow test.

Results

Overall, 750 (93.8%) valid training sessions were analyzed. The mean duration passed since training cessation was as follows: time point 1 = 13.9±9.9 minutes, time point 2 = 64.8±35.0 minutes, time point 3 = 430.9±181.4 minutes, and time point 4 = 1072.9±285.4 minutes, with an equal number of training sessions per time point. The analysis revealed HR-TRIMP, gender, and training type to be significant predictors of sRPE (all p<.011). HR-TRIMP, modeled as a third order orthogonal polynomial,

127

improved the model fit substantially and remained with statistical significance effects for the linear (p=.002), quadratic (p<.001), and cubic effect (p<.001). The interaction "time point x HR-TRIMP x training type" showed an overall effect on sRPE by trend (p=.090), implying that the time point of sRPE assessment does have some influence. The linear regressions analysis for the variables time point, gender, and training type are presented in Figure 1. The variables' category slopes were tested for equality, with the slopes being statistically different for time points (p=.015), gender (p<.001), and training types (p<.001). For time point 4, standing for the longest duration between training cessation and sRPE assessment, lower sRPE values were reported at a given HR-TRIMP compared to the previous time points (Figure 1A). Women reported lower sRPE values than men for the same objective HR-TRIMP (Figure 1B). Finally, for the same objectively measured HR-TRIMP smaller sRPE values were observed
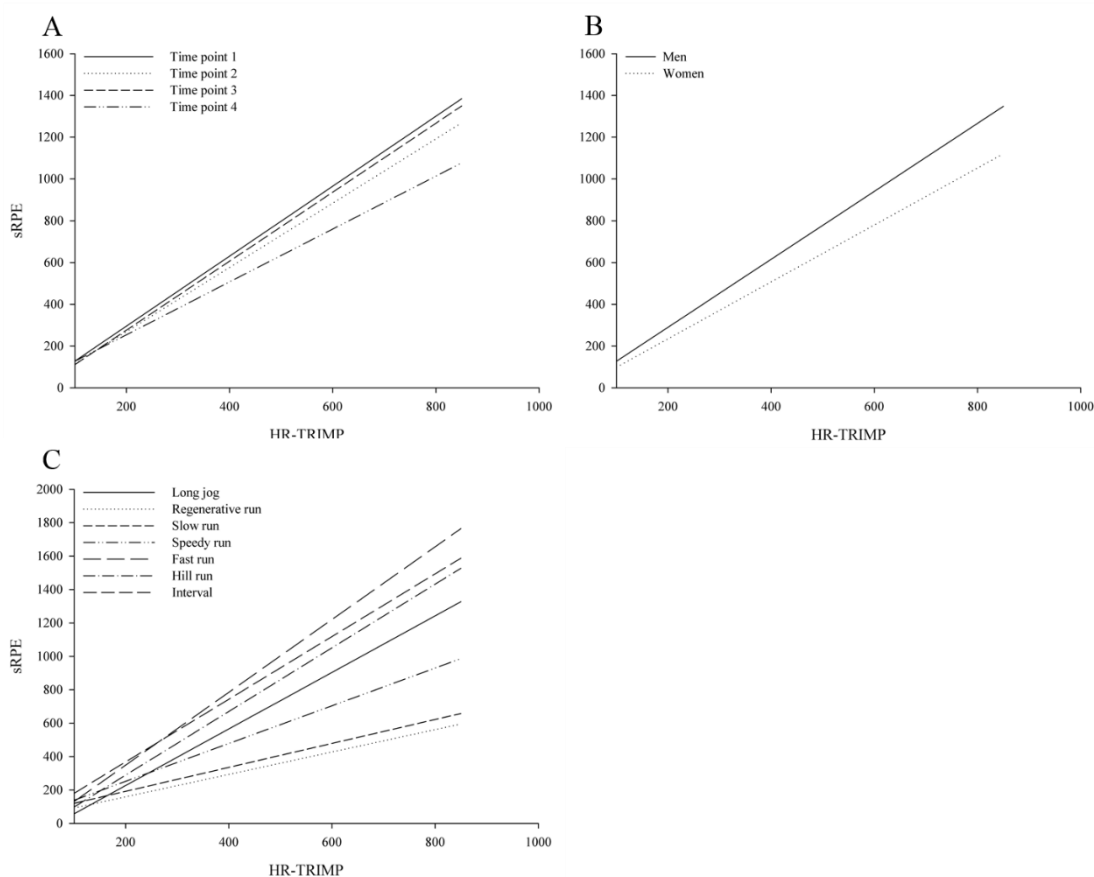
for regenerative runs compared to high-intensity running sessions (Figure 1C).

Figure 1. Linear regression slopes with session rating of perceived exertion (sRPE) as the dependent variable and objective measured training load (HR-TRIMP) as the independent variable for A) time points, B) gender, and C) training types.

Discussion/Conclusion

The analysis showed that HR-TRIMP, time point, gender, and training type had an effect on sRPE (Figure 1). The longer the period between training cessation and sRPE assessment, the lower the sRPE values at a given HR-TRIMP. These findings are in contrast to previous studies (Kraft, Green, & Thompson, 2014) that reported no significant differences concerning the length of the duration between the end of a training session and the sRPE assessment; however, only one study investigated a duration longer than 60 minutes, namely 24 hours (Christen, Foster, Porcari, & Mikat, 2016). In the present study, women reported lower sRPE values compared to men for the same HR-TRIMP. In the available literature, the results concerning gender differences between sRPE and HR are inconclusive. Some studies have reported no differences between gender (Herman, Foster, Maher, Mikat, & Porcari, 2006; Robertson et al., 2000). However, another study reported lower RPE values for women when performing resistance training at the same relative intensities as men (O'Connor, Poudevigne, & Pasley, 2002), similar to the current results. These authors explained the gender differences with the fact that the absolute weights lifted by women were lower. However, in the present study, HRmax did not differ between men and women. Additionally, differences depending on the type of training were observed

128

in the present study. This finding is in line with previous results reporting sRPE to be a sensitive method, which allows to differentiate between types and intensities of exercises to assess training load (Christen et al., 2016; Egan, Winchester, Foster, & McGuigan, 2006; Foster et al., 2001).

To conclude, sRPE is a feasible and recommendable method to monitor daily training load. However, the assessment method should be kept standardized for a given athlete and comparisons between male and female athletes are not recommended.

References

Christen, J., Foster, C., Porcari, J. P., & Mikat, R. P. (2016). Temporal robustness of the session RPE. *Int J Sports Physiol Perform,* 1-21. doi: 10.1123/ijspp.2015-0438

Edwards, S. (1993). *Heart rate monitor book*. Sacramento: Fleet Feet Press.

Egan, A. D., Winchester, J. B., Foster, C., & McGuigan, M. R. (2006). Using session RPE to monitor different methods of resistance exercise. *J Sports Sci Med, 5*(2), 289-295.

Foster, C., Florhaug, J. A., Franklin, J., Gottschall, L., Hrovatin, L. A., Parker, S., . . . Dodge, C. (2001). A new approach to monitoring exercise training. *J Strength Cond Res, 15*(1), 109-115.

Herman, L., Foster, C., Maher, M. A., Mikat, R. P., & Porcari, J. P. (2006). Validity and reliablity of the session RPE method for monitoring exercise intensity. *S Afr J Sports Med, 18*(1), 14-17.

Kraft, J. A., Green, J. M., & Thompson, K. R. (2014). Session ratings of perceived exertion responses during resistance training bouts equated for total work but differing in work rate. *J Strength Cond Res, 28*(2), 540-545. doi: 10.1519/JSC.0b013e31829b569c

O'Connor, P. J., Poudevigne, M. S., & Pasley, J. D. (2002). Perceived exertion responses to novel elbow flexor eccentric action in women and men. *Med Sci Sports Exerc, 34*(5), 862-868.

Robertson, R. J., Moyna, N. M., Sward, K. L., Millich, N. B., Goss, F. L., & Thompson, P. D. (2000). Gender comparison of RPE at absolute and relative physiological criteria. *Med Sci Sports Exerc, 32*(12), 2120-2129.

Roos, L., Taube, W., Brandt, M., Heyer, L., & Wyss, T. (2013). Monitoring of daily training load and training load responses in endurance Sports: What do coaches want. *Schw Zeitschr Sportmed Sporttraumatol, 61*(4), 30-36.
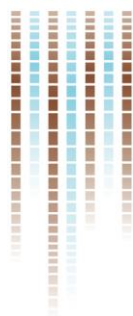
Visual processing and gaze

Title

Task-dependent gaze effects in perceptual-cognitive skill research. A case for temporal demands?

Authors/Affiliation

André Klostermann, Ernst-Joachim Hossner
Institute of Sport Science, University of Bern, Bern, Switzerland

Abstract

Introduction

Current research shows that simplified response modes entail severe problems with the results' external validity questioning the implications of research conducted so far (e.g., Savelsbergh, Williams, van der Kamp, & Ward, 2002). For example, Dicks, Button and Davids (2010) showed that soccer goalkeepers´ gaze behavior is affected by the degree of perception-action coupling, meaning, that goalkeepers looked at the penalty takers' kinematics especially in experimental conditions requiring simplified response modes instead of actual actions. This finding was explained with specific functional requirements; however, a possible confounder might reside in different timing demands to be present in the different response modes tested by Dicks et al. (2010). Exactly this alternative explanation was tested in the current study and it was expected to find increased tracking of the opponents´ kinematics in test situations with lower timing demands.

Methods

Thirty-two sport science students had to verbally predict the outcome of beach-volleyball attacks presented in occluded video scenes in a condition with (TD) and without (nTD) timing demands (counter-balanced order) on a life-sized screen. The participants' gaze behavior was measured with an integrated mobile eye-tracking system (EyeSeeCam, 220 Hz) and verbal responses were put down in writing. Gaze distribution to five cues (attacker, ball, future attacking position, setter and blocker) was calculated and aggregated as viewing times. The dependent measures were analyzed with repeated-measures ANOVAs and planned t-Tests.

Results

For viewing times, a significant main effect for cue was found (p < .01, η_p^2 = .93) with most allocations to the attacker, followed by the ball, the predicted ball-hand contact and least allocations at the setter and block player. Furthermore, a significant cue x condition interactions (_p_s < .05, η_p^2 > .13) was revealed elucidating that, different than expected, increased tracking of the attacker and decreased allocations to the ball were found in the TD when compared to the nTD condition (all _p_s < .05, all _d_s > 0.42). Additional analyses of the gaze behavior as a function of response accuracy revealed that allocations at the attacker rather were associated with incorrect and allocations at the future attacking position rather were associated with correct decisions (all _p_s < .01, all _d_s > 0.53).

Discussion/Conclusion

The current results show that task-specific differences in gaze behavior (Dicks et al., 2010) cannot be explained by different timing demands. Instead, the differences in gaze behavior, indeed, seem to rely on different functional requirements for the visual system (vision for perception vs. vision for action, cf. Millner & Goodale, 2008). However, the underlying mechanisms of this distinction remain unclear and further research is required. Furthermore, the analyses of the gaze behavior as a function of response accuracy replicated earlier findings regarding the functionality of the proactive gaze anchoring (Hossner, Klostermann, Kredel, Schläppi-Lienhard, & Vater, 2016). It is speculated that this anchoring supports the peripheral perception of more than one objects for anticipation.

References

Dicks, M., Button, C., & Davids, K. (2010). Examination of gaze behaviors under in situ and video simulation task constraints reveals differences in information pickup for perception and action. _Attention, Perception, & Psychophysics_, _72_, 706-720.

Hossner, E.-J., Klostermann, A., Kredel, R., Schläppi-Lienhard, O., & Vater, C. (2016). _Decision making and gaze strategies in beach volleyball defense: On expertise and the maximization of information_. Manuscript in preparation.

Milner, A. D., & Goodale, M. A. (2008). Two visual systems re-viewed. _Neuropsychologia_, _46_, 774-785.

130

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Visual processing and gaze

Savelsbergh, G. J., Williams, A. M., Kamp, J. V. D., & Ward, P. (2002). Visual search, anticipation and expertise in soccer goalkeepers. *Journal of Sports Sciences*, *20*, 279-287.

Visual processing and gaze

Title

The influence of a visual non-target in an aiming task: The football penalty kick case

Authors/Affiliation

Martina Navarro[1], John van der Kamp[2], Geert Savelsbergh[2]
Institute of Sport Science, University of Bern, Bern, Switzerland; Faculty of Human Movement Science, Vrije University Amsterdam, Amsterdam, The Netherlands;

Abstract

Introduction

According with the response activation model (Welsh & Elliot, 2004) objects surround a target may influence the outcome of an aiming action by either veering it away or towards the non-target object. The model proposes that prior to execute an action the attention is distributed around the environment and as a result, both target and non-target objects activate automatic independent and parallel responses. The result of the combined activation determines the details of the final action. Inhibitory processes are responsible for stopping responses for the non-target, however salient non-targets objects are difficult to be inhibited. The penalty kick might be considered a aiming task with the presence of a salient non-target (i.e. the goalkeeper) if the kicker adopts the goalkeeper-independent strategy (van der Kamp, 2006). In this case, the response activation model assumes that the presence of a goalkeeper may affect the placement of the ball relative to a target. This study investigates whether a kicker adopting the goalkeeper-independent strategy can completely ignore the mere presence of a goalkeeper during a penalty kick.

Methods

Ten intermediate-level football players were instructed to adopt a goalkeeper-independent strategy and to perform penalty kicks aiming at one of two targets located in the upper corners of the goal under three conditions: without a goalkeeper (NG), in the presence of a goalkeeper (who tried to save the ball-G), and in the presence of a goalkeeper who was informed by the kickers the side of the kick (IG). Each participant performed 20 kicks per condition in two blocks of 10, total of 60 kicks. The frequency of hits (ball hit the target), miss (ball inside the goal, but missed the target) and failures (balls outside the goal) per condition were counted and submitted to a chi-square analysis. The absolute and variable errors (in cm) from the distance between the ball landing and the center of the goal were calculated and submitted to a RM-ANOVA. Finally, the average ball speed was calculated and submitted to a RM-ANOVA.

Results

The results of the chi-square revealed that the mere presence of a goalkeeper impaired shot accuracy, i.e the number of hits, misses and failures were different across conditions ($P < 0.001$), being the number of hits higher for the NG condition. Also, the shots in the goalkeeper presence were more centralised, i.e. biased toward him/her according with the results from the RM-ANOVA for the absolute ($P < 0.01$) and variable error ($P > 0.05$). The effects were enhanced for the IG condition. No difference in ball speed across condition was found.

Discussion/Conclusion

The findings were consistent with the response activation model that holds that aiming at a target can be biased toward salient visual non-targets. The results indicate that kickers' performance is affected by the presence of a goalkeeper by reducing the number of hits on the target and by centralizing (i.e. closer to the goalkeeper) the shots. The non-significance results for variable error and ball speed reveals that this bias towards the goalkeeper is genuine and not product of speed-accuracy trade-off.

References

Welsh, T. N., & Elliott, D. (2004). Movement trajectories in the presence of a distracting stimulus: Evidence for a response activation model of selective reaching. The Quarterly *Journal of Experimental Psychology*, 57, 1031–1057.

van der Kamp, J. (2006). A field simulation study of the effectiveness of penalty kick strategies in soccer: Late alterations of kick direction increase errors and reduce accuracy. *Journal of Sport Sciences*, 24, 467–477.

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Visual processing and gaze

Title

Gaze behaviour in pirouettes – does spotting help to keep a dancer stable?

Authors/Affiliation

Andrea Schärli[1], Heiko Hecht[2], Fred Mast[3],Ernst-Joachim Hossner[1]

[1]_Institute of Sport Science, University of Bern, Bern, Switzerland; _[2]_Institute of Psychology, Johannes Gutenberg-University, Mainz, Germany, _[3]_Institute of Psychology, University of Bern, Bern, Switzerland_

Abstract

Introduction

The present study seeks to investigate more closely the role of spotting in ballet dancers. During spotting - a specific gaze behaviour adopted by dancers during consecutive turns – the head and gaze are fixed to a single 'spot' as long as possible while the rest of the body rotates. When this fixation can no longer be maintained, the head quickly rotates, overtaking the rest of the body to face the original spot once again. It could be hypothesised that spotting is functional in preventing dizziness, or that it is unrelated to dizziness but rather facilitates precise realignment of the body in the spatial reference framework and therefore guarantees postural stability. In the former case the role of the vestibular system would be crucial; in the latter case the visual reference frame would be most important. The present study aims to uncover - in a first step - whether spotting helps postural stability after repeated body rotation and whether dizziness is less distinct after rotations with than without spotting.

Methods

Therefore, we tested a sample of 24 amateur dancers (and we will test a sample of 24 expert dancers) for postural stability after they have turned consecutively around their longitudinal axis. For the passive turning condition, participants were rotated 14 times on a rotating chair with and without spotting. In the active turning condition, participants performed 14 consecutive turns with and without spotting at a constant speed (as instructed by the beats of a metronome). Before and after the rotations, Centre-of-Pressure (COP) displacement in quiet stance was measured on a force plate to examine postural stability. Moreover, to examine the dancers' dizziness, participants indicated their perception of vertigo after-effect measured by self-assessment using a 0 – 20 scale (Keshavarz & Hecht, 2011). A one-way repeated measures ANOVA will be adopted to examine differences in postural stability and dizziness perception after the different turning conditions.

Results

Preliminary analyses revealed a difference in COP displacement between rotations with and without spotting in both the active and passive turning conditions for the amateur dancers. At the Conference, we will present an extensive summary of the data analysis for the 24 amateur dancers. We also plan to present data of the up-coming measurements with the expert dancers.

Discussion/Conclusion

Postural stability after consecutive whole body rotations with and without spotting has not been studied so far or only indirectly. Thus, the results will provide important insights on the role of spotting for balance in dance, relevant to researchers of postural control and dance professionals alike.

References

Keshavaz, B., & Hecht, H. (2011). Validating an efficient method to quantify motion sickness. _Human factors, 53(4)_, 415-426
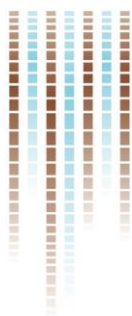
Poster 1

Title

Hurdle detection and leading leg identification using foot-worn inertial sensors in 400m hurdles races.

Authors/Affiliation

Christina Maria Bauer [1], Mathieu Falbriard[1], Kamiar Aminian[1]

[1]Laboratory of Movement Analysis and Measurement, Swiss Federal Institute of Technology in Lausanne, Lausanne, Switzerland

Abstract

Introduction

Hurdling performances rely on the running speed and technique of the athlete but also on the strategy adopted during the race. The number of steps between hurdles and the time at each of them are two of the main analysis criteria used by the coaches to improve athlete's performances. Recent studies have assessed the potential of Inertial Measurement Units (IMUs) to fill the gap between subjective observational running analysis and bulky in-laboratory installations [1], thus suggesting they could be valid candidates for 400m hurdle races analysis. The goal of this project is to investigate the capacity of foot-worn inertial sensors to detecting hurdles.

Methods

In this study, we measured 11 athletes during one 400m hurdle races. Athletes were wearing an IMU on the upper part of both feet recording the foot acceleration and angular velocity at 500 Hz. In addition, the race was caught on video cameras at 50 Hz for verification purpose. Using the foot medio-lateral axis angular velocity signal, we were able to detect the midswings events and segment the race accordingly. We then implemented algorithms capable of detecting initial contact and toe-off and combine those parameters to detect when the athlete is passing over each hurdle. In addition, as the distance between hurdles is constant, we were able to estimate the average step length.

Results

Using our algorithms, we were able to identify 100% of the steps during which the athlete was passing over the hurdle. Consequently, we were also able to detect the leading leg for all the hurdles with a 100% accuracy.

Discussion/Conclusion

The goal of this project was to investigate if algorithms using foot-worn inertial sensors could detect when the time at which an athlete is passing over a hurdle. The results show that our system can accurately identify those steps and can also accurately identify the leading leg. However, with the current results we cannot estimate with a resolution lower than a step when the foot is passing over the hurdle. Finally, detecting each step also allow to estimate the average step length between hurdle since the distance separating them is constant.

References

[1] Fong, D. T. P., & Chan, Y. Y. (2010). The use of wearable inertial motion sensors in human lower limb biomechanics studies: a systematic review. Sensors, 10(12), 11556-11565.

Poster 2

Title

A comparison of two military-specific sensor-systems to estimate energy expenditure in soldiers

Authors/Affiliation

Beeler Nadja[1], Veenstra Bertil[2], Buller Mark[3], Delves Simon[4], Roos Lilian[1] & Wyss Thomas[1]

[1]Swiss Federal Institute of Sport Magglingen SFISM, Magglingen, Switzerland; [2]Institute of Training Medicine & Training Physiology, MOD/TGTF, Utrecht, the Netherlands; [3]Biophysics and Biomedical Modelling Division, United States Army Research Institute of Environmental Medicine, Natick, USA; [4]Environmental Medicine & Science, Institute of Naval Medicine, Alverstoke, Hampshire, UK

Abstract

Introduction

Physical demands during military service are high (Wyss, Scheffler, & Mäder, 2012). To avoid a misbalance between physical requirements and abilities and to prevent overuse injuries, it is crucial to quantify the demands of military-specific activities. One indicator frequently used for this purpose is energy expenditure. Researchers from Switzerland and the Netherlands each developed algorithms for energy expenditure estimation in a military setting. The present study aimed to compare data of the Swiss and the Dutch sensor-system during military marching with values of the compendium of physical activities (Ainsworth et al., 2011).

Methods

Data of 64 male Swiss soldiers were collected during a military 35 km march. All subjects wore the sensors of the Swiss and the Dutch sensor-system simultaneously. The Swiss sensor-system developed by Wyss & Mäder (2011) consisted of two PARTwear accelerometers (HuCE microLab, Biel/Bienne, Switzerland) worn at the hip and the backpack as well as a wrist worn heart rate sensor (Mio FUSE, Mio Global, Vancouver, Canada). Only the heart rate values of the Mio FUSE are used in the Swiss algorithm; however, the device also provides its own estimation of energy expenditure, which was included in the analysis as well. The Dutch algorithm relies on acceleration data from the chest belt EQ-02 (Hidalgo Ltd, Cambridge, UK) and known algorithms for different activities (e.g. Pandolf formula (1978) for walking). As a reference value, energy expenditure was calculated according to Ainsworth et al. (2011) in 1-minute intervals. For military marching with backpack, code 17012 corresponding to 7.8 MET and for breaks, code 07040 corresponding to 1.8 MET was used. An one-way ANOVA with Bonferroni post-hoc tests (level of significance set at $p<0.05$) was conducted to investigate differences between the sensor-systems.

Results

In total, the data of 46 subjects (age 20.3±1.3 years; height 178.7±7.1 cm; weight 76.2±10.0 kg) was included in the analysis. The reference method revealed a total energy expenditure of 17.3±2.3 MJ during the whole march (around 490 minutes, of which 80 minutes were spent resting). The Swiss sensor-system showed no significant differences from the reference value but large standard deviations (mean overestimation of 8.0±19.7%). While the Dutch sensor-system significantly underestimated energy expenditure by -27.8±6.7%, the Mio FUSE showed a significant overestimation of the energy expenditure by 23.9±19.8%.

Discussion/Conclusion

In the present study, the Swiss sensor-system demonstrated the most accurate energy expenditure estimation during military marching compared to the reference value. The values from the Dutch sensor-system and the Mio FUSE significantly differed from the same. However, the relevance of this study is limited since no measured reference data, assessed with a gold-standard method is available.

References

Ainsworth, B. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett, D. R., Jr., Tudor-Locke, C., Leon, A. S. (2011). 2011 Compendium of Physical Activities: a second update of codes and MET values. _Med Sci Sports Exerc, 43_(8), 1575-1581.

Pandolf, K., B. Givoni, and R. Goldman. (1978) Predicting energy expenditure with loads while standing or walking very slowly. _J. Appl. Physiol, 43,_ 577-581.

Poster 2

Wyss, T., & Mäder, U. (2011). Energy expenditure estimation during daily military routine with body-fixed sensors. *Military Medicine, 176*(5), 494-499.

Wyss, T., Scheffler, J., & Mäder, U. (2012). Ambulatory physical activity in Swiss Army recruits. *International Journal of Sports Medicine, 33*, 716-722.

Poster 3

Title

Measure of efficiency and knee isokinetic strength in bike messengers and non-cyclist athletes

Authors/Affiliation

Paul Gilliéron[1], Cyril Besson[2], Mathieu Saubade[2], Gérald Gremion[2], Jérôme Pasquier[3]

[1]Faculty of Biology and Medicine, University of Lausanne and Lausanne University Hospital, Lausanne, Switzerland; [2]Swiss Olympic Medical Center, Sport Medicine Unit, Lausanne University Hospital, Lausanne, Switzerland; [3]Institute of Social and Preventive Medicine, Lausanne University Hospital, Lausanne, Switzerland

Abstract

Introduction

Gross efficiency in cycling (GE) seems to be correlated with lower body strength (Loveless, Weber, Haseler, & Schneider, 2005). The purpose of this study was to investigate GE at 4 different pedaling rates (60, 70, 90, 100 rpm) and its relationship with an isokinetic strength test in bike messengers (BM) and in experienced athletes non-bike messengers (NBM).

Methods

8 BM (age 25.2 ± 3,2, working in a delivery company, doing 218.7 ± 65.1 km/week, 19.6 ± 11.1 hours of sport per week) and 8 NBM (age 25.4 ± 2.2, doing 5 ± 14.1 km/week, 6.5 ± 3.8 hours of sport per week) underwent 2 laboratory sessions. On the first visit, they completed an incremental test on ergocycle (30W/min) to determine MAP and $\dot{V}O_{2max}$. On the second visit, they first performed an efficiency test at 50% of MAP. Four cadences (60, 70, 90 and 100 rpm) were randomly tested during 5 minutes. At each cadence, GE, $\dot{V}O_2$, heart rate (HR) and blood lactate concentration (BLC) were measured. Then, the subjects underwent an isokinetic test in which concentric strength of the extensors and flexors of dominant knee were tested (5 repetitions at 60°/sec and 20 at 120°/sec). Fatigability and peak torque/body weight (Bw) were kept for analysis.

Results

A difference in GE (at 60, 90 100 rpm), BLC (all cadences) and MAP/kg in favor of BM was found (all P-values<0.05). No difference in $\dot{V}O_2/\dot{V}O_{2max}$ (all cadences) was found. The most efficient cadence is 60 rpm in both groups. Along with increased cadence, GE worsens and HR and $\dot{V}O_2$ increase in both groups. BLC only increases in the NBM group. In both groups, a clear relationship between MAP/kg and low BLC was found. BM have stronger knee flexors strength than NBM (P-value R=0.038, p<0.001). No relationship between GE at different cadence, peak-torque/Bw and muscle fatigability was found.

Discussion/Conclusion

BM shows a better GE than NBM. Those results are in line with previously described analysis (Chavarren & Calbet, 1999) and explained by better aerobic capacity, training status (Hopker, Coleman, & Wiles, 2007), muscle fiber type (Coyle, Sidossis, Horowitz, & Beltz, 1992), pedaling technique (Leirdal & Ettema, 2011). At the same power output, anaerobic glycolysis plays a greater role in NBM which is linked with a less economic GE. Stronger hamstring muscles in BM could be explained by the pulling effort developed on the bike when using clip bicycle shoes but isokinetic knee maximal strength and fatigability does not seem to be linked with GE.

References

Chavarren, J., & Calbet, J. A. (1999). Cycling efficiency and pedalling frequency in road cyclists. *Eur J Appl Physiol Occup Physiol, 80*(6), 555-563. doi: 10.1007/s004210050634

Coyle, E. F., Sidossis, L. S., Horowitz, J. F., & Beltz, J. D. (1992). Cycling efficiency is related to the percentage of type I muscle fibers. *Med Sci Sports Exerc, 24*(7), 782-788.

Hopker, J. G., C

Title

Perfusion of lower back muscles in an isometric challenge – a pilot study

Poster 3

oleman, D. A., & Wiles, J. D. (2007). Differences in efficiency between trained and recreational cyclists. *Appl Physiol Nutr Metab, 32*(6), 1036-1042. doi: 10.1139/h07-070

Leirdal, S., & Ettema, G. (2011). Pedaling technique and energy cost in cycling. *Med Sci Sports Exerc, 43*(4), 701-705. doi: 10.1249/MSS.0b013e3181f6b7ea

Loveless, D. J., Weber, C. L., Haseler, L. J., & Schneider, D. A. (2005). Maximal leg-strength training improves cycling economy in previously untrained men. *Med Sci Sports Exerc, 37*(7), 1231-1236.

Poster 4

Title

Effects of aging on sensory integration during single-leg stance: A spectral analysis approach

Authors/Affiliation

Eduard Kurz[1,2], Oliver Faude[1], Ralf Roth[1], Roland Grassme[2], Lukas Zahner[1], Lars Donath[1]

[1]Department of Sport, Exercise and Health, University of Basel, Basel, Switzerland; [2]Clinic for Trauma, Hand and Reconstructive Surgery, Division of Motor Research, Pathophysiology and Biomechanics, Jena University Hospital, Jena, Germany

Abstract

Introduction

The control of upright standing is linked to an adequate integration of multisensory inputs. Those inputs mainly rely on visual, vestibular and proprioceptive afferents. Different proportions of the total power spectrum density of center of pressure (COP) signals enable the quantification of individual sensory inputs. This investigation was aimed at examining aging effects on sensory contributions to standing balance in children, adults and seniors.

Methods

Children (age: 9-10 years, m/f: 10/9), adults (age: 20-25 years, m/f: 20/10) and seniors (age: 53-79 years, m/f: 16/13) were recruited to participate voluntarily. Standing balance was measured via 30 s of single-leg stance (dominant leg) using a force plate (GK-1000, Mittweida). Each participant successfully completed the task. The contributions of the visual, vestibular and proprioceptive systems to postural stabilization are linked to energies within the low (LF, 0-0.3 Hz), medium (MF, 0.3-1.0 Hz) and high (HF, 1-3 Hz) frequency bands, respectively. The anterior-posterior displacements of COP were used to calculate proportions of LF, MF and HF bands from the total power spectrum. The amount of energy in each band was normalized by the sum within the three bands (Kanekar et al. 2014). Age-group effects were computed using a univariate analysis of variance (ANOVA). To estimate practical relevance, effect sizes (partial eta squared, η_p^2) were calculated. Post hoc tests were carried out to verify between-group differences.

Results

The univariate ANOVA revealed an effect of age-group ($P < 0.001$) for LF ($F = 7.7$, $\eta_p^2 = 0.17$), MF ($F = 11.7$, $\eta_p^2 = 0.24$) as well as for HF ($F = 13.0$, $\eta_p^2 = 0.26$). Subsequent post hoc tests indicated differences for LF; both children and adults differed from lower seniors' levels ($P < 0.01$). Adults' MF band revealed a higher proportion than in children or seniors ($P < 0.001$). Children and seniors, on the contrary, revealed higher proportions in the HF band as compared with adults ($P < 0.001$).

Discussion/Conclusion

As a compensatory function of aging-induced proprioceptive deteriorations (Goble et al. 2009), we found a higher relative contribution of the proprioceptive afferents in seniors. Most of the previous studies on aging effects solely quantified sensorimotor tasks rather than proprioception alone (Benjuya et al. 2004). It seems that adults' postural input mainly relies on vestibular sources (higher magnitude in MF band) compared to children and seniors. Thus, frequency analysis of COP signals might be a useful approach to elucidate changes of sensory subsystems following different balance training intervention programs in various age-groups.

References

Benjuya, N., Melzer, I., & Kaplanski, J. (2004). Aging-induced shifts from a reliance on sensory input to muscle cocontraction during balanced standing. *J Gerontol A Biol Sci Med Sci, 59*(2), 166-171.

Goble, D. J., Coxon, J. P., Wenderoth, N., Van Impe, A., & Swinnen, S. P. (2009). Proprioceptive sensibility in the elderly: degeneration, functional consequences and plastic-adaptive processes. *Neurosci Biobehav Rev, 33*(3), 271-278.

Kanekar, N., Lee, Y. J., & Aruin, A. S. (2014). Frequency analysis approach to study balance control in individuals with multiple sclerosis. *J Neurosci Methods, 222*, 91-96.

Poster 5

Title

Peripheral muscle fatigue is linked to type-II cross sectional area in the elderly

Authors/Affiliation

Julia M. Kröpfl[1*], Joel Bondietti[1*], Thomas U. Wüthrich[1], David Aguayo[1], Severin Papa[1], Marco Toigo[2], Christina M. Spengler[1]

[1] _Exercise Physiology Lab, Institute of Human Movement Sciences and Sport, ETH Zurich, Switzerland_
[2] _Balgrist University Hospital, Zurich, Switzerland_
[*] _both authors contributed equally_

Abstract

Introduction

Muscle strength is influenced by muscle cross-sectional area (CSA) and fiber type composition. Especially in the elderly, it is unclear to which extent these muscle characteristics influence volitional and non-volitional muscle force. To address this, quadriceps twitch contractile properties prior to (pre) and after (post) a fatiguing knee-extension task were related to fiber type CSAs.

Methods

Thirteen healthy, untrained elderly men (63.9 ± 2.6 years) participated in the study and all agreed to a vastus lateralis biopsy to assess fiber-type specific CSAs. Total quadriceps muscle CSA (CSA_Q) and fiber-type specific muscle CSA (CSA_I and CSA_{II}) were estimated by modeling thigh lean mass by means of a DXA scan. Potentiated quadriceps twitches were elicited by supramaximal magnetic femoral nerve stimulation before and immediately after fifty maximal, isokinetic knee extensions at $180°/s$.

Results

Significantly lower post-exercise values were observed in twitch amplitude (Q_{tw}: pre 47.8 ± 13.0, post 39.8 ± 12.2 Nm, $p<0.01$), rate of torque development (RTD: pre 1416 ± 645, post 1216 ± 575 Nm s^{-1}, $p<0.05$), relaxation rate (RR: pre -488.5 ± 160.5, post -394.6 ± 138.3 Nm s^{-1}, $p<0.01$) and maximal voluntary torque (MVT: pre 183.5 ± 38.9, post 167.2 ± 33.0 Nm, $p<0.001$) while voluntary activation (VA: pre 88.9, post 86.6 %, $p>0.05$) remained unchanged. Single twitch characteristics pre exercise were not related to CSA_Q, CSA_I and CSA_{II}, but pre-MVT showed a significant relationship with CSA_Q (pre: $r=0.73$, $p<0.05$) as well as CSA_{II} ($r=0.71$, $p<0.05$). Fatigue-related twitch characteristics, i.e. pre-to-post differences (Δ) in Q_{tw}, RTD and RR, were significantly associated with CSA_{II}: ΔQ_{tw} ($r=-0.78$, $p<0.01$), ΔRTD ($r=-0.64$, $p<0.05$) and ΔRR ($r=0.77$, $p<0.01$), while a trend was observed for ΔMVT ($r=-0.51$; $p<0.1$). A stepwise regression model to predict CSA_{II} (dependent variable) including ΔQ_{tw}, ΔRTD, ΔRR and ΔMVT as predictive parameters resulted in ΔQ_{tw} being the only significant predictor of CSA_{II} ($CSA_{II}=-0.91*\Delta Q_{tw} +17.25$; both $\beta<0.01$, $r^2=0.58$).

Discussion/Conclusion

The change in single twitch characteristics in an intense fatiguing task may potentially serve as a non-invasive tool to predict CSA_{II} in untrained, elderly men.

140

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Poster 6

Title

Myocardial infarction does not affect circulating hematopoietic stem and progenitor cell proliferative capacity in a rat model

Authors/Affiliation

Julia M. Kröpfl[1], Christina M. Spengler[1], Aurélien Frobert[2], Guillaume Ajalbert[2], Marie-Noelle Giraud[2]

[1]_Institute of Human Movement Sciences and Sport, Exercise Physiology Lab, ETH Zurich, Switzerland;_
[2]_Cardiology, University of Fribourg, Switzerland_

Abstract

Introduction

Acute myocardial infarction (MI) frequently occurs during increased physical activity and is associated with increased levels of immune cells (Tsujioka et al., 2009), as well as bone marrow (Assmus et al., 2012) and peripheral blood (Assmus et al., 2012; Leone et al., 2005) hematopoietic stem and progenitor cells (HSCs) with bone marrow HSC function being elevated after infarction. However, this was only assessed within the 1st week after infarction while post-acute changes and the function of HSCs in peripheral blood were not assessed. Due to its importance in post-acute regeneration, this study aimed to investigate count and function of HSCs in peripheral blood during 6 weeks after MI.

Methods

Myocardial infarction was induced in 9 female Lewis inbred rats by ligation of the left coronary artery. Peripheral blood was withdrawn before (day0) as well as 14, 21, and 42 days after MI. After mononuclear cell isolation, primary and secondary functional colony-forming unit-granulocyte macrophage (CFU-GM) assays were performed in order to detect the kinetics of functional HSC colonies and cell proliferative capacity in vitro. Blood cell counts and fractional shortening (FS) of the left ventricle were also determined.

Results

CFU-GM count and cell function remained unchanged ($p > 0.05$) 2 weeks after MI. A significant reduction in CFU-GM count was first visible on day 21 (vs. day0, $p < 0.01$ and day14, $p < 0.05$), while on day42, no further change had occurred. Higher day-0 CFU-GM counts were associated with lower FS on day21 and 42 ($r = -0.76$, $r = -0.70$, $p < 0.05$). Absolute and relative monocyte counts on day14 showed a trend to positively correlate with FS on day42 ($\rho = 0.65, \rho = 0.64$; $p = 0.06$).

Discussion/Conclusion

Myocardial infarction did not negatively affect circulating HSC function, which suggests a constant regenerative potential. Cardiac contractile function 21 and 42 days after MI was related to day-0 circulating CFU-GM count. Day14 infarct-induced monocytes may be linked to day42 FS. This suggests a potential for functional HSC count and monocyte count to predict outcome post-infarction.

References

Assmus, B., Iwasaki, M., Schachinger, V., Roexe, T., Koyanagi, M., Iekushi, K., Xu, Q., Tonn, T., Seifried, E., Liebner, S., Kranert, W. T., Grunwald, F., Dimmeler, S., & Zeiher, A. M. (2012). Acute myocardial infarction activates progenitor cells and increases Wnt signalling in the bone marrow. _Eur Heart J, 33_(15), 1911-1919. doi:10.1093/eurheartj/ehr388

Leone, A. M., Rutella, S., Bonanno, G., Abbate, A., Rebuzzi, A. G., Giovannini, S., Lombardi, M., Galiuto, L., Liuzzo, G., Andreotti, F., Lanza, G. A., Contemi, A. M., Leone, G., & Crea, F. (2005). Mobilization of bone marrow-derived stem cells after myocardial infarction and left ventricular function. _Eur Heart J, 26_(12), 1196-1204. doi:10.1093/eurheartj/ehi164

Tsujioka, H., Imanishi, T., Ikejima, H., Kuroi, A., Takarada, S., Tanimoto, T., Kitabata, H., Okochi, K., Arita, Y., Ishibashi, K., Komukai, K., Kataiwa, H., Nakamura, N., Hirata, K., Tanaka, A., & Akasaka, T. (2009). Impact of heterogeneity of human peripheral blood monocyte subsets on myocardial salvage in patients with primary acute myocardial infarction. _J Am Coll Cardiol, 54_(2), 130-138. doi:10.1016/j.jacc.2009.04.021
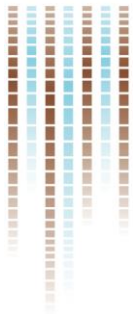
Poster 7

Title

Nonnegative matrix factorization to assess spatiotemporal muscle activation

Authors/Affiliation

Didier Staudenmann[1], Andreas Daffertshofer[2], Dick F. Stegeman[2], Jaap H. van Dieën[2]

[1]Movement and Sport Science, Department of Medicine, University of Fribourg, 1700 Fribourg, Switzerland; [2]MOVE Research Institute, Vrije Universiteit Amsterdam, The Netherlands

Abstract

Introduction

The distribution of activity can change across a muscle. Such spatial heterogeneity of muscle activity has been assessed by comparing EMG amplitudes between channels within a grid of electrodes (Farina, 2008). That procedure, however, involves averaging amplitudes over time and, hence, discards temporal information. As an alternative method a k-means clustering has been applied considering both temporal and spatial information (Staudenmann, 2009). However, this clustering approach requires a priori knowledge of the number of clusters present. Typically this number can only be estimated. If that estimate is incorrect, the clustering may yield an inadequate representation of muscle activity. The aim of the current study was to explore the utility of nonnegative matrix factorization (NMF) in the quantification of temporal and spatial variability of muscle activation.

Methods

In eight subjects we measured surface EMG (49±8 electrodes covering the entire biceps brachii) during two contraction types: 1) pure elbow flexion (Fl) and 2) elbow flexion with a superimposed forearm supination (FlSu). The monopolar EMGs were spatially filtered with principal component analysis (Staudenmann, 2006), rectified, smoothened, and normalized to maximum voluntary contraction. We used NMF (Lee, 1999) to decompose spatiotemporal EMG envelopes into a common signal (CS) and its gain distribution (GD). Furthermore, we quantified the common signal's correlation distribution (CD) and a value describing spatiotemporal heterogeneity by the overall variance accounted for (VAF).

Results

VAF was significantly (43%) larger for FlSu than in Fl (89±3% vs. 51±9%). CD showed 28% higher mean, 57% lower standard deviation, and 70% lower mean gradient in FlSu. This hints at less heterogeneity of the spatial activation pattern than in Fl. In contrast, GD showed only a 13% larger mean gradient in FlSu suggesting more variability of the envelopes of closely spaced electrodes over the muscle for FlSu than Fl.

Discussion/Conclusion

Our findings render NMF a powerful method for quantifying spatiotemporal muscle activation. NMF does not depend on a priori knowledge of spatial characteristics (e.g. number of spatial clusters), but exploits all temporal and spatial information. The VAF and spatial correlation were sensitive to the contraction type, while the spatial gain represented by GD was not. It can be concluded that the outcomes proposed were sensitive to contraction types and can be interpreted in a physiologically meaningful way.

References

Farina, D., et al. (2008). The change in spatial distribution of upper trapezius muscle activity is correlated to contraction duration. *J Electromyogr Kinesiol*, 18(1), 16-25.

Staudenmann, D., et al. (2009). Heterogeneity of muscle activation in relation to force direction: a multi-channel surface electromyography study on the triceps surae muscle. *J Electromyogr Kinesiol*, 19(5), 882-895.

Staudenmann, D., et al. (2006). Improving EMG-based muscle force estimation by using a high-density EMG grid and principal component analysis. *IEEE Trans Biomed Eng,* 53(4), 712-719.

142

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Poster 8

Authors/Affiliation

Andrea Vrana[1], Brigitte Wirth[1], Barry Kim Humphreys[1], Martin Flück[2]

[1]_Interdisciplinary Spinal Research, Department of Chiropractic Medicine, University Hospital Balgrist, Zurich;_ [2]_Laboratory for Muscle Plasticity , University of Zurich, Balgrist Campus, Zurich_

Abstract

Introduction

Chronic lower back pain (CLBP) is the most common musculoskeletal disorder worldwide and it is suggested that patients with CLBP show deconditioning of back muscles (Olivier, Thevenon, Berthoin, & Prieur, 2013). In deconditioned muscles the capacity for hyperemia is expected to be significantly decreased (Bogdanis, 2012). However, in spite of numerous studies investigating back muscle perfusion and fatigability in patients with CLBP, only inconsistent results currently exist (Verbunt et al., 2003). The aim of our pilot study was to characterize muscle perfusion in a healthy subject during the Biering-Sørensen test (Biering-Sorensen, 1984), which is regarded as the gold standard for the evaluation of back muscle endurance using a commercial functional near-infrared spectroscopy (fNIRS). This pilot should serve as a baseline for measurements in patients with CLBP.

Methods

The pilot dataset is comprised of four fNIRS measurements in one single healthy subject (male; 38 years). Measurements were standardized regarding daytime and physical activity within the previous 24 hours. After a baseline measurement of 5 minutes, the subject was advised to hold the isometric challenge until exhaustion, followed by a 2 minute recovery time. Muscle oxygen saturation (SmO_2) and total hemoglobin (tHb) were measured with a sampling rate of 0.5 Hz. Probes were set bilaterally on the M. iliocostalis, measuring two symmetric muscular compartments at the height of the 2nd and 3rd lumbar vertebrae. Kinetics of both SmO_2 and tHb were descriptively compared as a function of time during the Biering-Sørensen test.

Results

The four trials lasted for 2:45 minutes (1th trial), 2:35 minutes (2nd trial), 2:55 minutes (3rd trial) and 3:00 minutes (4th trial). Kinetics of SmO_2 and tHb showed a negative relationship: in SmO_2, there was a steep and large initial decrease followed by a linear decrease until termination of the isometric challenge; in tHb, there was either a small initial drop or a small fluctuation, followed by a linear increase until termination of the isometric challenge. Lower levels of tHb went in parallel with higher SmO_2 levels. This effect was more pronounced on the right M. iliocostalis.

Discussion/Conclusion

These pilot measurements showed good agreement with existing literature regarding SmO_2 depletion and its kinetics. An interesting finding which has to be reproduced in a larger cohort is that the SmO_2 and tHb kinetics showed a negative relationship. A possible interpretation is that blood flow (i.e. amount of tHb) has been restricted by sustained contraction of the muscle which in turn restricted mitochondrial activity due to limited O_2 levels for the intracellular respiratory chain (Hoppeler, Hudlicka, & Uhlmann, 1987). This might suggest that mitochondrial extraction of O_2 represents the limiting factor regarding the performance in the Biering-Sørensen test.

References

Biering-Sorensen, F. (1984). Physical measurements as risk indicators for low-back trouble over a one-year
period. [Research Support, Non-U.S. Gov't]. Spine (Phila Pa 1976), 9(2), 106-119.
Bogdanis, G. C. (2012). Effects of physical activity and inactivity on muscle fatigue. _Front Physiol, 3_,142. doi: 10.3389/fphys.2012.00142
Hoppeler, H., Hudlicka, O., & Uhlmann, E. (1987). Relationship between mitochondria and oxygen consumption in isolated cat muscles. [Research Support, Non-U.S. Gov'tReview]. _J Physiol, 385_, 661-675.
Olivier, N., Thevenon, A., Berthoin, S., & Prieur, F. (2013). An exercise therapy program can increase oxygenation and blood volume of the erector spinae muscle during exercise in chronic low back pain patients. _Arch Phys Med Rehabil, 94_(3), 536-542. doi: 10.1016/j.apmr.2012.10.028

Poster 8

Verbunt, J. A., Seelen, H. A., Vlaeyen, J. W., van de Heijden, G. J., Heuts, P. H., Pons, K., & Knottnerus, J. A. (2003). Disuse and deconditioning in chronic low back pain: concepts and hypotheses on contributing mechanisms. [Review]. *European journal of pain, 7*(1), 9-21.
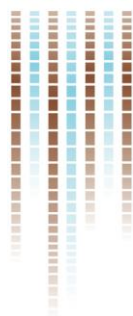
Poster 9

Title

Acute and long-term effects of respiratory muscle training on indexes of cardiovascular health in young healthy adults

Authors/Affiliation

Fernando G. Beltrami, David Mzee, Corina E. Schaer, Christina M. Spengler

Exercise Physiology Lab, Institute of Movement Sciences and Sport, ETH Zurich, Switzerland

Abstract

Introduction

Whole-body exercise training is often not a feasible alternative for elderly or diseased populations with reduced mobility, who are in a dire need for interventions that can improve and/or restore the cardiovascular system. Respiratory muscle training (RMT) is an alternative intervention for people with reduced mobility (Scherer et al. 2000), but the effects of this exercise modality on the cardiovascular system remains unknown. Pulse wave velocity (PWV), a measure of arterial stiffness with strong prognostic value for cardiac risk (Willum-Hansen et al., 2006), has been shown to respond similarly to interventions after acute and chronic exposures, i.e. interventions that lead to acute reductions in stiffness also show chronic reductions, and vice-versa (Currie et al., 2009; Heffernan et al., 2007). Therefore, the aim of the present study was to test to which degree single sessions of RMT or a 4-week RMT program could result in changes in PWV and other markers of cardiovascular health.

Methods

To assess acute effects, sixteen young and healthy participants (8m/8f) performed – on separate days – 15min of either continuous hyperpnea (RMET), sprint-intervall-type hyperpnea (RMSIT) or a control session (quiet sitting). Arterial stiffness was assessed by measuring PWV prior to as well as 5 and 15 min after each of the above 15-min protocols. To assess training-induced adaptations, thirty-four young and healthy participants (17m/17f) were measured before and after 4 weeks of RMET (n=13), RMSIT (n=11) or placebo (n=10). RMET consisted of twenty 30-min sessions of normocapnic hyperpnea at 60-85% of maxima voluntary ventilation (MVV); RMSIT involved three weekly sessions (12 sessions in total) of 6x 1min (1 min break) normocapnic hyperpnea at 55-65%MVV with added in- and expiratory resistance; and SHAM consisted of one inhalation / session (4-5 sessions/week, 20 in total) of a sham bronchodilating substance followed by 5 vital capacity manoeuvres. Pre to post intervention and pre to post training changes were compared using 2-way analysis of variance with Tukey post hoc when required (p < 0.05).

Results

Carotid-femoral PWV was higher by $2.0 \pm 5.0\%$ at 5 min post intervention compared to baseline (main effect of time, P=0.01), an effect that was not present anymore at 15 min post. Only RMET showed significant within-day changes ($+3.6 \pm 5.2\%$, P=0.001). Carotid-radial and Carotid-distal PWV did not change significantly (P=0.69 and P=0.49). Following the 4-week training period, however, no changes were detected in any of the groups for carotid-femoral (P=0.85), carotid-radial (P=0.56) or carotid-distal PWV (P=0.30), neither did systolic (P=0.55), diastolic (P=0.24) or mean arterial pressure (P=0.44) change.

Discussion/Conclusion

Although 15 min of the different RMT regimens induced a small but significant increase in carotid-femoral PWV, no negative changes were detected following 4 weeks of the different RMT programs. Whether these interventions would have positive (or larger negative) effects in more frail populations with more room for improvement remains to be established.

References

Currie, K. D., Thomas, S. G., & Goodman, J. M. (2009). Effects of short-term endurance exercise training on vascular function in young males. *European Journal of Applied Physiology*, *107*(2), 211–218.

Heffernan, K. S., Collier, S. R., Kelly, E. E., Jae, S. Y., & Fernhall, B. (2007). Arterial stiffness and baroreflex sensitivity following bouts of aerobic and resistance exercise. *International Journal of Sports Medicine*, *28*(3), 197–203.

Scherer, T. ., Spengler, C. M., Owassapian, D., Imhof, E., & Boutellier, U. (2000). Respiratory muscle

Poster 9

endurance training in chronic obstructive pulmonary disease: Impact on exercise capacity, dyspnea, and quality of life. *American Journal of Respiratory and Critical Care Medicine*, *162*(5), 1709–1714.

Willum-Hansen, T., Staessen, J. a, Torp-Pedersen, C., Rasmussen, S., Thijs, L., Ibsen, H., & Jeppesen, J. (2006). Prognostic value of aortic pulse wave velocity as index of arterial stiffness in the general population. *Circulation*, *113*(5), 664–70.

Poster 10

Title

Influence of a 12-week vitamin D supplementation on vitamin D status and muscle performance in wheelchair athletes

Authors/Affiliation

Joëlle Leonie Flueck[1], Max Walter Schläpfer[2] and Claudio Perret[1]

[1]Institute of Sports Medicine, Swiss Paraplegic Centre, Nottwil, Switzerland; [2]Institute of Human Movement Sciences and Sport, ETH Zurich, Zurich, Switzerland

Abstract

Introduction

A high prevalence of vitamin D deficiency was shown not only in infants and in the elderly but also in healthy able-bodied (Quadri et al., 2016) and spinal cord injured athletes (Flueck, Hartmann, Strupler, & Perret, 2016). Vitamin D seems to have a direct impact on neuromuscular function by docking on vitamin D receptors in the muscle tissue. Further studies with able-bodied athletes showed that performance might possibly be influenced by vitamin D status (Cannell, Hollis, Sorenson, Taft, & Anderson, 2009; Larson-Meyer & Willis, 2010; Wyon, Koutedakis, Wolman, Nevill, & Allen, 2014). Therefore, the aim of our study was to investigate whether a vitamin D dose of 6000 IU daily over 12 weeks would be sufficient to increase vitamin D status in indoor wheelchair athletes to a normal or optimal vitamin D level and whether vitamin D deficiency is associated with an impairment in muscle performance in these individuals.

Methods

Vitamin D status was assessed in indoor elite wheelchair athletes in order to have a baseline measurement. If vitamin D status was below 75 nmol/L, athletes were supplemented with 6000 IU of vitamin D daily over 12 weeks. A vitamin D status over 75 nmol/L was supplemented with a placebo supplement. Vitamin D status, as well as a Wingate test and an isokinetic dynamometer test, were performed at baseline and after 6 and 12 weeks of supplementation. After 12 week of supplementation, athletes ingested during another 12 week a placebo supplement in order to have a follow up period. Again, Wingate and isokinetic dynamometer tests were performed pre and post follow up.

Results

20 indoor elite wheelchair athletes participated in this double-blind study. All of these athletes showed an insufficient vitamin D status at baseline (44.0 ± 18.2 nmol/L) and were, therefore, supplemented with vitamin D. All athletes increased vitamin D status significantly (p < 0.001) over 12 weeks and reached an optimal level (167.4 ± 32.0 nmol/L). Wingate performance was not significantly increased (p = 0.09) even though most athletes increased their peak power over the 12 week duration. Isokinetic dynamometer strength was significantly increased but only in the non-dominant arm in isometric (p = 0.019) and concentric elbow flexion (p = 0.001).

Discussion/Conclusion

A dose of 6000 IU of vitamin D daily during 12 weeks seems to be sufficient to increase vitamin D status to an optimal level in indoor wheelchair athletes. It remains unclear, whether upper body performance or muscle strength and vitamin D status are associated with each other in this population.

References

Cannell, J. J., Hollis, B. W., Sorenson, M. B., Taft, T. N., & Anderson, J. J. (2009). Athletic performance and vitamin D. [Review]. *Med Sci Sports Exerc, 41*(5), 1102-1110. doi: 10.1249/MSS.0b013e3181930c2b

Flueck, J. L., Hartmann, K., Strupler, M., & Perret, C. (2016). Vitamin D deficiency in Swiss elite wheelchair athletes. *Spinal Cord*. doi: 10.1038/sc.2016.33

Larson-Meyer, D. E., & Willis, K. S. (2010). Vitamin D and athletes. [Review]. *Curr Sports Med Rep, 9*(4), 220-226. doi: 10.1249/JSR.0b013e3181e7dd45

Quadri, A., Gojanovic, B., Noack, P., Fuhrer, C., Steuer, C., Huber, A., & Kriemler, S. (2016). *Seasonal variation of vitamin D levels in Swiss athletes* (Vol. 64): Swiss Sports & Exercise Medicine.

Poster 10

Wyon, M. A., Koutedakis, Y., Wolman, R., Nevill, A. M., & Allen, N. (2014). The influence of winter vitamin D supplementation on muscle function and injury occurrence in elite ballet dancers: a controlled study. [Controlled Clinical Trial]. *J Sci Med Sport, 17*(1), 8-12. doi: 10.1016/j.jsams.2013.03.007

Poster 11

Title

Acute effects of respiratory warm-up on exercise-induced bronchoconstriction and exercise performance

Authors/Affiliation

Philipp A. Eichenberger[1], Thomas A. Scherer[2], Christina M. Spengler[1,3]

[1]Exercise Physiology Lab, Institute of Human Movement Sciences and Sport, ETH Zurich, Zurich, Switzerland; [2]LungenZentrum Hirslanden, Zurich; [3]Zurich Center for Integrative Human Physiology (ZIHP), University of Zurich, Zurich, Switzerland

Abstract

Introduction

Short bouts of whole-body warm-up exercises were shown to protect airways by attenuating bronchoconstriction in response to subsequent intense exercise in people with exercise-induced bronchoconstriction (EIB, Stickland et al., 2012). Whether intense respiratory warm-up offers similar refractoriness and whether this might negatively affect exercise performance is unknown.

Methods

Nine subjects with EIB (25±5 yrs; forced expiratory volume in 1s [FEV_1], 104±15% predicted) performed an exercise challenge (ECh) followed – after 30min - by a constant-load cycling test to exhaustion (CL). The ECh was preceded by one of four conditions: by i) no warm-up (NWU) or by 10min of normocapnic hyperpnea with partial rebreathing at either ii) 50% (WU50) or iii) variable intensity (8x 30s-80%/45s-30%; WU80/30), or at iv) 70% (WU70) of maximal voluntary ventilation. FEV_1 was measured at baseline and in 5-min intervals until 15min after NWU/warm-up and 30min after ECh. None of the warm-up conditions induced EIB.

Results

The maximal decrease in FEV_1 after the ECh was -14.9±3.6% in NWU which was significantly attenuated after WU50 (-9.3±5.0%), WU70 (-7.2±5.0%), and WU80/30 (-8.6±7.5%), with no difference between warm-up conditions (p>0.05). Workload and ventilation during ECh did not differ between conditions. In NWU, FEV_1 immediately before the CL was still significantly reduced compared to baseline and WU-conditions (all p≤0.05). Only on the NWU test day, FEV_1 remained significantly reduced up to the start of CL (−9.3 ± 4.2%, p≤0.05). CL performance did not differ significantly between test days (NWU: 13 ± 7min; WU50: 14 ± 9min; WU70: 14 ± 7min; WU80/30: 13 ± 9min; all p>0.05).

Discussion/Conclusion

These data indicate that intense respiratory warm-up carried out before whole-body exercise can attenuate EIB severity and improve recovery, even in the absence of significant airway narrowing acutely after warm-up, while they do not compromise CL performance.

References

Stickland, M. K., Rowe, B. H., Spooner, C. H., Vandermeer, B., & Dryden, D. M. (2012). Effect of warm-up exercise on exercise-induced bronchoconstriction. *Medicine and Science in Sports and Exercise, 44*(3), 383-391.

Poster 12

Title

Repetitive, intense hyperpnea does not change perception of bronchoconstriction despite reduced bronchial reactivity in asthmatics - a pilot study

Authors/Affiliation

Philipp A. Eichenberger[1], Andrea C. Kurzen[1], Stephanie N. Diener[1], Thomas A. Scherer[2], Christina M. Spengler[1,3]

[1]Exercise Physiology Lab, Institute of Human Movement Sciences and Sport, ETH Zurich, Switzerland; [2]LungenZentrum Hirslanden, Zurich; [3]Zurich Center for Integrative Human Physiology (ZIHP), University of Zurich, Switzerland

Abstract

Introduction

Exercise training was shown to slightly reduce bronchial hyperresponsiveness and symptoms in asthma (Eichenberger et al., 2013; Franca-Pinto et al., 2015). The underlying mechanisms are not yet fully elucidated. One aspect may be repetitive airway stretching with increased ventilation during exercise. Isolated repetitive, intense hyperpnea would be a training option but concern exists that an asthma attack would be recognized too late due to potentially reduced perception of air hunger (AH) and respiratory exertion (RE). The aim of the present pilot was therefore to test whether isolated repetitive, intense hyperpnea would positively affect bronchial hyperresponsiveness, airway inflammation and reduce perception of AH and RE during a mannitol challenge.

Methods

Eight subjects (age: 24±4 yrs; forced expiratory volume in 1s [FEV_1]: 88±14% pred.) with mild-moderate asthma participated in this study. Prior to and after an 11-week intervention, FEV_1 and the bronchial response to a mannitol challenge (airway sensitivity, PD_{15}; response-dose-ratio of FEV_1, RDR FEV_1) with assessment of exhaled nitric oxide concentration (eNO), perception of AH and RE (assessed after each dose) were performed after withdrawal of medication. The slope of the relationship between AH or RE and ΔFEV_1 was determined by linear regression for each subject. The intervention included fourty 30-min sessions of normocapnic hyperpnea with warm and humid air (4-5x/wk) at 60-78% of maximal voluntary ventilation.

Results

After the intervention, bronchial response (PD_{15}, pre: 362±238 mg, post: 460±222 mg, p=0.031; RDR FEV_1, pre: -0.11±0.18%·mg^{-1}, post: -0.04±0.05%·mg^{-1}, p=0.008) and eNO (pre: 47±27 ppb, post: 37±26 ppb, p=0.016) were significantly reduced. However, slopes of AH·ΔFEV_1^{-1} (p=0.078) and RE·ΔFEV_1^{-1} (p=0.078) of the mannitol challenge remained unchanged.

Discussion/Conclusion

This data indicates that repetitive airway stretching and respiratory muscle work may contribute to the positive effects of exercise in asthmatics and that isolated breathing training is safe as the sensitivity of the perception of bronchoconstriction remained unchanged and might therefore be a non-pharmacological and airway specific exercise modality to improve bronchial hyperresponsiveness and airway inflammation in asthmatics.

References

Eichenberger, P. A., Diener, S. N., Kofmehl, R., & Spengler, C. M. (2013). Effects of exercise training on airway hyperreactivity in asthma: a systematic review and meta-analysis. _Sports Medicine, 43_(11), 1157-1170.

Franca-Pinto, A., Mendes, F. A., de Carvalho-Pinto, R. M., Agondi, R. C., Cukier, A., Stelmach, R., Saraiva-Romanholo, B. M., Kalil, J., Martins, M. A., Giavina-Bianchi, P., & Carvalho, C. R. (2015). Aerobic training decreases bronchial hyperresponsiveness and systemic inflammation in patients with moderate or severe asthma: a randomised controlled trial. _Thorax, 70_(8), 732-739.

Poster 13

Title

Novel incremental respiratory muscle test to predict whole-body $\dot{V}O_{2peak}$

Authors/Affiliation

Corina E. Schaer [1], Fernando G. Beltrami [1], Thomas U. Wüthrich [1], Christina M. Spengler [1, 2]

[1] Exercise Physiology Lab, Institute of Human Movement Sciences and Sport, ETH Zurich, Switzerland, [2] Zurich Center for Integrative Human Physiology (ZIHP), University of Zurich, Switzerland

Abstract

Introduction

Peak oxygen consumption ($\dot{V}O_{2peak}$) assessed during an incremental exercise test is a strong predictor of mortality in healthy individuals (Myers et al., 2002) and a good parameter for risk assessment of peri-operative complications (Licker et al., 2011). However, the evaluation of $\dot{V}O_{2peak}$ during whole-body exercise is often not possible, e.g. in patients with neuromuscular or joint impairments, thus leaving a large number of patients potentially without access to a valuable risk assessment tool. Although different strategies for $\dot{V}O_{2peak}$ prediction were suggested (Jones et al., 1985), adding a functional measurement could further improve the quality of such estimations. One possibility would be maximal respiratory muscle performance determined by a novel incremental respiratory muscle test (IncRMT), a test that does not require activity from the upper or lower limbs.

Methods

36 (18m/18f) healthy participants (age: 26±5 years, $\dot{V}O_{2peak}$: 48±10 ml·min^{-1}·kg^{-1}) performed an incremental cycling test to exhaustion for $\dot{V}O_{2peak}$ assessment and, on a different day, an IncRMT. For the IncRMT, we developed a custom-made rebreathing device enabling accurate constant step-wise increases in work of breathing (WOB) achieved by increasing respiratory resistance and ventilation. IncRMT performance, heart rate (HR) and lung function parameters were entered in a backwards stepwise linear regression model to determine the best predictors of whole-body $\dot{V}O_{2peak}$. The model initially contained IncRMT WOB, test duration (T_{lim}), power of breathing (POB_{max}), resting heart rate (HR_{rest}), the ratio of HR_{rest} to predicted maximal heart rate ($HR_{rest}·HR_{max}^{-1}$) and forced vital capacity (FVC). Data using the final prediction model was compared to data using the single variable (FVC) prediction of $\dot{V}O_{2peak}$ suggested by Jones _et al._, (1985).

Results

The combination of WOB and FVC resulted in the best prediction of $\dot{V}O_{2peak}$ ($\dot{V}O_{2peak,pred}$[ml·min^{-1}]=0.1·WOB[J]+613.5·FVC[L]-442.1; R^2=0.79; $p<0.001$; SEE 436.9ml·min^{-1}). Within subject analysis of residuals between predicted and measured $\dot{V}O_{2peak}$, via Bland and-Altman plot, revealed a bias of -0.002±546ml·kg^{-1} with 95% LoA of [-1070-1070] ml·kg^{-1} for the single-variable model with FVC and a bias of -18.11±417ml·kg^{-1} with 95% LoA of [-835-799]ml·kg^{-1} for the multivariable model with the combination of FVC and WOB. The new model reduced the 95%LoA by 24% compared to the single variable model.

Discussion/Conclusion

Respiratory muscle work of breathing assessed during the IncRMT provides, together with FVC, a more accurate prediction of whole-body $\dot{V}O_{2peak}$ in healthy individuals than the estimation by FVC alone. This suggests that the IncRMT is a good functional test to predict cardiovascular fitness. Since respiratory muscle function affects surgical outcome (Siafakas et al., 1999), performance in this test may be used as an assessment tool for peri-operative complications. However, to evaluate the potential of the IncRMT to assess peri-operative complications in immobile patients, further investigations in different age- and patient-groups are needed.

References

Jones, N. L., Makrides, L., Hitchcock, C., Chypchar, T., & McCartney, N. (1985). Normal standards for an incremental progressive cycle ergometer test. _The American Review of Respiratory Disease_, _131_(5), 700–8

Licker, M., Schnyder, J. M., Frey, J. G., Diaper, J., Cartier, V., Inan, C., … Tschoppe, J. M. (2011). Impact of aerobic exercise capacity and procedure-related factors in lung cancer surgery. _European Respiratory Journal_, _37_(5), 1189–1198

Myers, J., Prakash, M., Froelicher, V., Do, D., Partington, S., & Atwood, J. E. (2002). Exercise capacity and mortality among men referred for exercise testing. _N Engl J Med_, _346_(11), 793–801

Siafakas, N. M., Mitrouska, I., Bouros, D., & Georgopoulos, D. (1999). Surgery and the respiratory muscles. _Thorax_, _54_(5), 458–465

Poster 14

Title

Sex difference in performance adaptation with respiratory muscle training

Authors/Affiliation

Corina E. Schaer [1], Désirée Erne [1], Dina Tageldin [1], Thomas U. Wüthrich [1], Fernando G. Beltrami [1], Jan Stutz [1], Christina M. Spengler [1, 2]

[1]_Exercise Physiology Lab, Institute of Human Movement Sciences and Sport, ETH Zurich, Switzerland,_
[2]_Center for Integrative Human Physiology (ZIHP), University of Zurich, Switzerland_

Abstract

Introduction

Women's inspiratory muscles are believed to be less fatigable than those of men during high intensity cycling (Guenette et al., 2010) despite increased respiratory mechanical constraints, i.e. smaller airways relative to lung size (Thurlbeck, 1982). A possible explanation might be the repetitive exposure to high levels of respiratory muscle work during exercise in women, resulting in increased resistance to fatigue. Respiratory muscle endurance training (RMET) can improve respiratory muscle fatigue resistance and even whole body exercise performance (Illi et al., 2012), however, most of the studies performed to date used male participants, and very few studies investigated performance adaptations in females. Given the possibility that women might have 'naturally' better trained respiratory muscles, the purpose of this study was to examine potential sex differences in response to traditional RMET and also to a novel, less time-consuming respiratory muscle sprint-interval training, RMSIT (Wüthrich et al., 2015).

Methods

34 participants (age: 26±6years, peak oxygen consumption: 49±10ml$\cdot$min^{-1}$\cdot$kg^{-1}) were randomized and balanced into 3 groups (m/f; RMET 6/6; RMSIT 5/6; SHAM 5/6). Pulmonary function, 12-km cycling time trial (TT) performance and quadriceps muscle fatigue (change in twitch force [ΔQ_{tw}]) were assessed pre and post a 4-weeks respiratory muscle training intervention. RMET consisted of twenty 30-min sessions (4-5 sessions/week) of normocapnic hyperpnea at 60-85% maximal voluntary ventilation (MVV), RMSIT consisted of 12 sessions (3 sessions/week) of 6x 1min of normocapnic hyperpnea at 55-65% MVV with added in- and expiratory resistance, alternating with 1-min breaks and SHAM consisted of twenty sessions (4-5 sessions/week) of one inhalation of a SHAM bronchodilating substance followed by five vital capacity manoeuvres.

Results

MVV_{12} improved after RMET in males and after RMSIT in females (RMET m/f: 7.9±6.8l$\cdot$min^{-1} / 9.1±9.5l$\cdot$min^{-1}; RMSIT m/f: 7.3±20.5l$\cdot$min^{-1} / 13.2±5.0l$\cdot$min^{-1}, SHAM m/f: 8.8±8.8l$\cdot$min^{-1} / -1.3±10.4l$\cdot$min^{-1}). TT performance improved in males after RMET compared to SHAM (RMET m/f: -88±83s / +44.5±171s, RMSIT m/f: +14±58s / +25±145s, SHAM m/f: +90±73s / -63±99s) while no significant change in performance was observed in either sex after RMSIT. However, males in RMSIT, perceived less respiratory exertion during the TT (RMET m/f: -0.0±0.9 / -0.5±1.0, RMSIT m/f: -1.7±0.9 / +0.2±1.4, SHAM m/f: +0.7±1.6 / -0.2±2.4) with a trend towards less leg exertion (p=0.052). ΔQ_{tw} after TT did not change in any group.

Discussion/Conclusion

The different responses to RMT between males and females support the hypothesis that women's respiratory muscles are more fatigue resistant than those of men. This increased fatigue resistance in women may mean that their exercise performance may be less limited by their respiratory system which would be supported by the lack of improvement in TT performance after respiratory muscle training. Hence, when interpreting study results, gender effects should be taken into consideration.

References

Guenette, J. A., Romer, L. M., Querido, J. S., Chua, R., Eves, N. D., Road, J. D., … Sheel, A. W. (2010). Sex differences in exercise-induced diaphragmatic fatigue in endurance-trained athletes, 35–46.

Illi, S. K., Held, U., Frank, I., & Spengler, C. M. (2012). Effect of respiratory muscle training on exercise performance in healthy individuals: a systematic review and meta-analysis. _Sports Medicine (Auckland, N.Z.)_, _42_(8), 707–24

Thurlbeck, W. M. (1982). Postnatal human lung growth. _Thorax_, _37_(8), 564–571.

Wüthrich, T. U., Marty, J., Benaglia, P., Eichenberger, P. A., & Spengler, C. M. (2015). Acute Effects of a Respiratory Sprint-Interval Session on Muscle Contractility. _Medicine and Science in Sports and Exercise_, _47_(9), 1979–1987.

152

9. Jahrestagung der SGS in Zürich
9e congrès annuel 4S à Zurich
WWW.SPORTWISSENSCHAFT.CH
WWW.SCIENCESDUSPORT.CH

Poster 15

Title
Acute cardiorespiratory responses to lower body positive pressure.

Authors/Affiliation
Uva Barbara, Stucky Frédéric, Kayser Bengt.
Institute of Sport Sciences, Faculty of Biology and Medicine, University of Lausanne

Abstract

Introduction
The anti-gravity treadmill Alter-G uses differential air pressure technology to provide bodyweight support thus facilitating locomotion for rehabilitation of patients. The lower-body positive pressure (LBPP) applied by the system may shift blood from the lower limbs towards the thorax, increasing venous return. The dynamics of the cardiorespiratory responses to LBPP remained to be described.

Methods
Nine healthy males (32.0±9.1 yrs, 179.5±5.9 cm, and 73.2±7.9 kg) stood upright on an anti-gravity treadmill (AlterG, Fremont, USA) and underwent sequences of 3 minutes LBPP at 15 and 40 mmHg. Stroke volume (SV), heart rate (HR), cardiac output (CO), mean arterial blood pressure (MAP) and peripheral resistance (PR) were monitored beat-by-beat (ModelFlow, Finapres Medical Systems, Amsterdam, NL) applied on non-invasive fingertip pulse pressure recordings; oxygen uptake (VO_2) was monitored breath-by-breath using a respiratory gas analyzer (MedGraphics, Loma Linda, USA).

Results
Within the first seconds of LBPP, SV increased (by 29.7±11.4 and 43.8±14.0 ml, corresponding to a 43% and 63% increase from baseline, at 15 and 40 mmHg, respectively ($p<0.05$)) while HR decreased (by 15.2±6.5 (-20%) and 22.2±9.4 (- 30%) bpm ($p<0.05$)), resulting in a transitory increase in CO (by 1.7±0.9 (+33%) and 2.1±1.0 $l.min^{-1}$ (+42%) ($p<0.05$)). This was accompanied by a transitory decrease in end-tidal PO_2 (by 5.7±1.8 (-6%) and 10.3±2.8 (-10%) mmHg ($p<0.05$)) and an increase in VO_2 (by 71.3±18.7 (+23%) and 137.9±46.5 (+54%) $ml.min^{-1}$ ($p<0.05$)), suggesting temporary increases in venous return, pulmonary blood flow and lung capillary recruitment. After 3 minutes of LBPP, initial changes were abolished in CO (5.1±0.9 vs 5.3±1.0 vs 5.3±1.1 $l.min^{-1}$, 0, 15, 40 mmHg LBPP (P=NS)), VO_2 (256.0±24.7 vs 256.4±35.6 vs 252.1±27.2 $ml.min^{-1}$ (P=NS)) and PR (1.2±0.4 vs 1.2±0.4 vs 1.3±0.5 PRU (P=NS)), despite HR (74.4±10.6 vs 66.4±8.5 vs 58.5±7.4 bpm (P<0.05)) and SV remaining altered (69.4±14.3 vs 81.1±18.6 vs 91.8±18.5 ml (P<0.05)). TPR and MAP showed an immediate increase followed by a rapid drop and a second, slower rise, with MAP at 40 mmHg LBPP remaining above baseline (92.3±13.3 vs 94.9±11.4 mmHg (P<0.05)) and gradually declining at 15 mmHg LBPP ((92.3±13.3 vs 98.4±16.1 mmHg (P=NS)) until pressure was released.

Discussion/Conclusion
Our observations suggest that (1) LBPP transiently increases venous return, pulmonary blood flow and lung capillary recruitment, thereby increasing pulmonary oxygen uptake beyond metabolic demand; (2) these effects of LBPP on CO and VO_2 are progressively abolished when LBPP is maintained, suggesting that vasomotor control mechanisms adapt to LBPP to keep oxygen delivery commensurate with demand.

References
Fu, Q., Y. Sugiyama, A. Kamiya and T. Mano (2000). "A comparison of autonomic responses in humans induced by two simulation models of weightlessness: lower body positive pressure and 6 degrees head-down tilt." J Auton Nerv Syst **80**(1-2): 101-107.

Nishiyasu, T., S. Hayashida, A. Kitano, K. Nagashima and M. Ichinose (2007). "Effects of posture on peripheral vascular responses to lower body positive pressure." Am J Physiol Heart Circ Physiol **293**(1): H670-676.

153

Poster 15

Shi, X., C. G. Crandall and P. B. Raven (1993). "Hemodynamic responses to graded lower body positive pressure." <u>Am J Physiol</u> **265**(1 Pt 2): H69-73.

Poster 17

Title

Sport and exercise in residential addiction treatment in Switzerland: Between research and reality

Authors/Affiliation

Flora Colledge[1], Markus Gerber[1], Angela Krieger[1], Philippe Franc[1], Uwe Pühse[1].

[1]Departement für Sport, Bewegung und Gesundheit, Universität Basel, Birsstrasse 320b, 4052 Basel

Introduction

Physical exercise is an essential component of human health, and there is also a strong evidential basis for its therapeutic effectiveness in a wide range of physical and psychological disorders. (Richardson et al., 2005; Taylor et al., 2004) Though the evidence for exercise as an adjunct treatment for addictive disorders is far more limited, existing studies show promising results. (Zschucke, Heinz, & Ströhle, 2012) To date, however, the degree to which exercise and sport is integrated into clinical practice has not been systematically documented. Consequently, little is known about whether recommendations from the literature are translated into practice. (Morris, Wooding, & Grant, 2011)

Methods

80 residential addiction clinics in Switzerland were contacted by telephone. Data concerning the existence, extent and nature of sport or exercise programmes at the clinic was collected. Furthermore, respondents were asked why the clinic chose to offer (or not offer) exercise, and whether they felt that such offers required national guidelines.

Results

60 clinics agreed to participate in the study. The great majority of clinics do offer an exercise programme. The structure of these programmes varies greatly between clinics, as does the training and background of the programme leaders. The effectiveness of the exercise programmes themselves are not objectively assessed or documented. A number of clinics would favour the introduction of national recommendations for exercise integration in this setting.

Discussion/Conclusion

While a number of studies have suggested that exercise is a valuable adjunct treatment in addiction therapy, and the majority of residential clinics in Switzerland include it, there are no standard recommendations for how such programmes should be integrated. Furthermore, there is no evidence-based implementation of exercise specifically targeting the physical and psychological comorbidities experienced by this population. The potential therapeutic effects of exercise in addiction treatment may be enhanced by targeted clinic-based programmes in which treatment-related outcomes are regularly assessed.

References

Morris, Z. S., Wooding, S., & Grant, J. (2011). The answer is 17 years, what is the question: understanding time lags in translational research. *Journal of the Royal Society of Medicine, 104*(12), 510-520. doi: 10.1258/jrsm.2011.110180

Richardson, C. R., Faulkner, G., McDevitt, J., Skrinar, G. S., Hutchinson, D. S., & Piette, J. D. (2005). Integrating physical activity into mental health services for persons with serious mental illness. *Psychiatric Services, 56*(3), 324-331. doi: 10.1176/appi.ps.56.3.324

Taylor, R. S., Brown, A., Ebrahim, S., Jolliffe, J., Noorani, H., Rees, K., Skidmore, B., Stone, J. A., Thompson, D. R., Oldridge, N. (2004). Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. *The American Journal of Medicine, 116*(10), 682-692. doi: http://dx.doi.org/10.1016/j.amjmed.2004.01.009

Zschucke, E., Heinz, A., & Strohle, A. (2012). Exercise and physical activity in the therapy of substance use disorders. *ScientificWorldJournal, 2012*, 901741. doi: 10.1100/2012/901741

Poster 18

Title:

Energy saving mechanisms in walking in obese individuals

Authors/Affiliation :

Aitor Fernandez Menendez[1], Gilles Saudan[1], Ludovic Sperisen[1], Mosè Canepa[1], Mathieu Saubade[2], Grégoire P. Millet[1] and Davide Malatesta[1]

[1]Institute of Sport Sciences (ISSUL), University of Lausanne, Lausanne, Switzerland; [2]Swiss Olympic Sports Medicine Center, Lausanne University Hospital, Switzerland

Abstract

Introduction

Recent studies have reported a higher cost of walking in obese compared with normal weight subjects when is expressed per kilogram of body mass. The metabolic cost of the biomechanical factors involved in this extracost should have end in a higher metabolic rate than the observed 11%. Some authors have hypothesized that this may be due to an improvement in exchange of kinetic and potential energies, as it was shown in African women carrying loads on their heads (Heglund et al., 1995). However, this increase in the pendular mechanism has not been found in obese (Malatesta et al., 2009). Therefore, compared to lean, obese individuals may optimize the storage and release of elastic energy as a catapult action (Ishikawa et al., 2005), recently assessed through the congruity in lean individuals (Balbinot, 2016). Therefore, the purpose of this study was to investigate the energy saving mechanisms in walking in obese individuals (i.e., recovery and congruity).

Methods

21 obese (O:4 Men,17 Women;age:33.2±7.0yr;BMI:33.7±2.7kg·m^{-2}) and 21 lean individuals (L:11 Men,10 Women;age:23.8±2.0yr; BMI:21.7±2.4 kg·m^{-2}), free of clinical signs of disease, participated in the study. Both groups performed 10 min of treadmill familiarization, followed by a resting period of 5 min, and 3 min of walking at 1.11 m·s^{-1}. Mechanical data was acquired during the last 30 seconds with an instrumented treadmill (HP-Cosmos 150MED, Arsalis; BTS Bioengineering). Ten strides were selected to analyze: the vertical displacement of COM (COMv), the positive and negative work done to increase and decrease, respectively, the kinetic (Wk+ and Wk-) and potential energies (Wp+ and Wp-), the ratio of positive kinetic and potential works (Wk+/Wp+), positive and negative external works (Wext+, Wext-, respectively), recovery (R) and congruity (C%) (Balbinot, 2016).

Results

No significant difference was found in Wk+ (O=0.42±0.04;L:0.41±0.05;p=0.43), Wk- (O=0.41±0.04;L: 0.40±0.05;p=0.44), Wp+ (O=0.48±0.07;L:0.45±0.05;p=0.12), Wp- (O=0.48±0.07;L:0.45±0.05;p=0.12), Wk+/Wp+ (O=0.89±0.15;L:0.93±0.13;p=0.40) and COMv (O=3.38±0.43;L:3.27±0.40;p=0.41) between groups. Whereas Wext+ and Wext- were significantly lower in obese (0.26±0.03J·Kg-1·m-1;0.25±0.04J·Kg^{-1}·m^{-1}; respectively) than in the control group (0.30±0.03J·Kg^{-1}·m^{-1};0.29±0.03J·Kg^{-1}·m^{-1}, respectively; p<0.001). R was significantly higher in obese (71.5±4.7%) as compared with control group (65.4±4.7%; p<0.001). Moreover, C% was significantly lower in obese (9.9±3.9%) than in normal body weight (13.5±3.5%; p=0.003).

Discussion/Conclusion

The main finding of this study was that the obese are able to shift potential and kinetic energies more out of phase than lean individuals, as it is shown with the higher R and lower C% values, respectively. The higher muscle-tendon unit stiffness, previously reported in obese compared with lean individuals (Faria et al., 2009), may be involved in the lower C% values and elastic energy usage during walking in obese than in lean individual. These results reveal that obese individuals may rely more on the pendular mechanism, rather than on the elastic energy storage and release, to decrease the amount of Wext performed and, therefore, limit the extra cost of walking.

References

Balbinot, G. (2016). Walking at non-constant speeds: mechanical work, pendular transduction, and energy congruity. *Scand J Med Sci Sports*. doi:10.1111/sms.12667

Faria, A., Gabriel, R., Abrantes, J., Bras, R., & Moreira, H. (2009). Triceps-surae musculotendinous stiffness: relative differences between obese and non-obese postmenopausal women. *Clin Biomech (Bristol, Avon), 24*(10), 866-871. doi:10.1016/j.clinbiomech.2009.07.015

Poster 18

Heglund, N. C., Willems, P. A., Penta, M., & Cavagna, G. A. (1995). Energy-saving gait mechanics with head-supported loads. *Nature, 375*(6526), 52-54. doi:10.1038/375052a0

Ishikawa, M., Komi, P. V., Grey, M. J., Lepola, V., & Bruggemann, G. P. (2005). Muscle-tendon interaction and elastic energy usage in human walking. *J Appl Physiol (1985), 99*(2), 603-608. doi:10.1152/japplphysiol.00189.2005

Malatesta, D., Vismara, L., Menegoni, F., Galli, M., Romei, M., & Capodaglio, P. (2009). Mechanical external work and recovery at preferred walking speed in obese subjects. *Med Sci Sports Exerc, 41*(2), 426-434. doi:10.1249/MSS.0b013e31818606e7
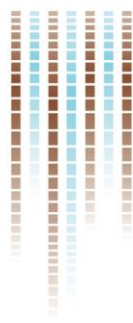
Poster 19

Authors

Fischer X, Zahner L, Faude O, Donath L

Departement für Sport, Bewegung und Gesundheit, Universität Basel, Schweiz

Abstract

Introduction

35% of Swiss adults are not meeting general physical activity recommendations (150 min of moderate or 75 min of vigorous physical activity (PA) per week)(BASPO, 2013). Physical inactivity (PI) is considered an independent cardiovascular risk factor and associated with various non-communicable diseases (Lee et al., 2012). Developing, launching and disseminating effective, evidence-based PA promotion programs have been repeatedly stipulated. Lifestyle interventions including individually tailored program components (Noar, Benac, & Harris, 2007), behavior change techniques (BCT) (Michie, Abraham, Whittington, McAteer, & Gupta, 2009), personal coaching and regular prompting are considered effective means to promote sustainable PA behavior change (Foster, Richards, Thorogood, & Hillsdon, 2013). The present project aims at developing, implementing and evaluating an individually tailored PA promotion program using evidence-based intervention techniques and a low threshold communicational setting without face-to-face contact. This contribution will describe the content and the procedure of the PA promotion program.

Methods

Ten BCTs (including "goal setting, "problem solving", "action planning" and "self-monitoring") were selected according to their effectiveness in previous studies. Those BCTs are delivered in 12 biweekly telephone coaching sessions implemented in a three armed randomized controlled trial. The three trial arms differ in terms of delivery method. A single written recommendation will be compared to telephone coaching with additional SMS that prompt behavioral change or a telephone coaching alone. All participants have access to a personalized coaching and self-monitoring profile on a webpage that enables the application of BCTs and simplifies the interaction between participant and coach (www.movingcall.com). Within the profile participants receive a weekly activity plan and are able to monitor their PA behavior. Recommendations and the selection of focused BCTs are tailored to psychosocial determinants of PA (e.g. self-efficacy, outcome expectations, social support), the current PA behavior as well as individual preferences and needs. These variables are assessed by online-questionnaires within the interactive profile. In order to individualize/actualize prompting and coaching, coaches have access to the data on the profile.

Results

Preliminary data of the study will be presented at the 9th SGS Annual Meeting.

Discussion

The project results in a functional and low cost PA promotion program without face-to-face contact. Effective intervention strategies are combined to address the essential barriers "motivation" and "time dispensability". In a next step, short and long-term effects of the PA promotion program will be evaluated. Further insights into effects of tailoring, coaching and prompting strategies based on utilizing adequate BCTs on PA promotion can be delivered.
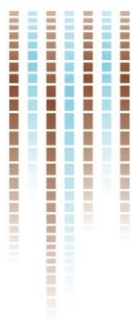
References

BASPO. (2013). Gesundheitswirksame Bewegung, Grundlagendokument. Magglingen: Bundesamt für Sport BASPO, Bundesamt für Gesundheit BAG, Gesundheitsförderung Schweiz, bfu - Beratungsstelle für Unfallverhütung, Suva, Netzwerk Gesundheit und Bewegung Schweiz.

Foster, C., Richards, J., Thorogood, M., & Hillsdon, M. (2013). Remote and web 2.0 interventions for promoting physical activity. Cochrane Database of Systematic Reviews, (9).

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., & Katzmarzyk, P. T. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet, 380(9838), 219-229.

Poster 19

Michie, S., Abraham, C., Whittington, C., McAteer, J., & Gupta, S. (2009). Effective techniques in healthy eating and physical activity interventions: a meta-regression. Health Psychology, 28(6), 690-701.

Noar, S. M., Benac, C. N., & Harris, M. S. (2007). Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. Psychological Bulletin, 133(4), 673-693.

Poster 20

Autor/Affiliation

Benjamin Rubeli[1], Achim Conzelmann[1], Mirko Schmidt[1]

[1]Institut für Sportwissenschaft, Universität Bern

Abstract

Introduction

Aus sportpsychologischer Perspektive ist die Frage nach dem Effekt von sportlicher Aktivität auf das Selbstwertgefühl bei Kindern und Jugendlichen von grosser Bedeutung (Stiller & Alfermann, 2005). Allerdings ist bislang eine empirische Bestätigung, dass Sport im positiven Sinne zur Selbstwertbildung beiträgt, nicht abschliessend gelungen. Eine mögliche Erklärung hierfür wird aus kognitionspsychologischer Perspektive im moderierenden Einfluss der Zentralität auf den Zusammenhang zwischen sportbezogenem Fähigkeitsselbstkonzept (sFSK) und Selbstwertgefühl gesehen (Marsh, 2008). Die geschlechtsspezifisch-normative Zentralität stellt zudem einen weiteren Erklärungsansatz für geschlechtsspezifische Unterschiede dieses Zusammenhangs dar (z.B. Seyda, 2011). Bis anhin wurden diese Erklärungsmechanismen mit Blick auf das frühe Jugendalter noch nicht hinreichend untersucht.

Methods

Vor dem Hintergrund dieser Forschungslücke wurde bei N = 252 Primarschulkindern (52.5% Mädchen; M_{Alter} = 11.3 Jahre, SD_{Alter} = 0.69) mit einer Strukturgleichungsmodellierung untersucht, ob die individuelle Zentralität den Effekt des sFSK auf das allgemeine Selbstwertgefühl moderiert. Mit einer Multigruppenanalyse wurde zudem getestet, ob die Knaben ihren sportlichen Fähigkeiten im Vergleich zu den Mädchen eine höhere Zentralität zuschreiben, und ob damit einhergehend das sFSK der Knaben einen stärkeren Effekt auf deren Selbstwertgefühl aufweist.

Results

Die deskriptiven und inkrementellen Fit-Indizes des Strukturgleichungsmodells weisen durchgehend akzeptable Anpassungsgüten an die empirischen Daten auf (χ^2= 68.45, p (df) = .028 (48), χ^2/df = 1.43, CFI = .954, RMSEA = .041, SRMR = .039). Erwartungsgemäss lassen sich ein signifikanter Effekt des sFSK (β = .76, p < .001, ΔR^2 = .471), kein signifikanter Effekt der Zentralität (β = .06, p = .672, ΔR^2 = .005) und ein signifikanter Effekt des Interaktionsfaktors (β = .16, p = .037, ΔR^2 = .028) auf das allgemeine Selbstwertgefühl feststellen. Obwohl bei den Knaben eine signifikant höhere Zentralität als bei den Mädchen festgestellt werden konnte ($M_\male$ = .29; $SD_\male$ = .54, $M_\female$ = 0, $SD_\female$ = .58, $\Delta\chi^2$ = 23.84, df = 5, p < .001, d = .51), zeigt sich zwischen den Geschlechtergruppen kein unterschiedlicher Effekt des sFSK auf das allgemeine Selbstwertgefühl ($\Delta\chi^2$ = 2.95, df = 3, p = .40).

Discussion/Conclusion

Die Befunde verweisen auf individueller Ebene auf einen schwachen moderierenden Einfluss der Zentralität bei Kindern im frühen Jugendalter, jedoch nicht auf geschlechtsspezifisch-normativer Ebene. Da Kinder ihre Ausprägung der Zentralität nicht zwingend an einem interindividuellen, sondern an einem intraindividuellen Referenzrahmen einstufen, wird eine Erklärung für die kontroverse Befundlage in der nicht berücksichtigten idiographischen Operationalisierung der Zentralität gesehen. Zudem können aufgrund des Querschnittstudiendesigns keine Aussagen über die zugrundeliegenden kausalen Wirkmechanismen gemacht werden. Weitere Forschungsbemühungen sind angezeigt, um diese offenen Fragen zu beantworten.

References

Marsh, H. W. (2008). The elusive importance effect: More failure for the Jamesian perspective on the importance of importance in shaping self-esteem. *Journal of Personality, 76*(5), 1081-1121.

Seyda, M. (2011). *Persönlichkeitsentwicklung durch Bewegung, Spiel und Sport. Die Bedeutung des Schulsports für die Selbstkonzeptentwicklung im Grundschulalter*. Aachen: Meyer & Meyer.

Stiller, J. & Alfermann, D. (2005). Selbstkonzept im Sport. *Zeitschrift für Sportpsychologie, 12*(4), 119 126.

Poster 21

Validation of a new instrument to assess physical activity in exercise and health science students: The Simple Physical Activity Questionnaire (SIMPAQ)

Authors/Affiliation

René Schilling[1], Xenia Fischer[1], Lukas Zahner[1], Oliver Faude[1], Lars Donath[1] , Markus Gerber[1]
[1]Departement of Sport, Exercise and Health, University of Basel, Basel, Switzerland

Abstract

Introduction

The accurate assessment of physical activity is still an important issue in sports, exercise and health sciences (Terwee et al., 2010). For instance, existing instrument such as the International Physical Activity Questionnaire have been criticized for being lengthy or overestimating participants' physical activity levels (Rosenbaum & Ward, 2016). Therefore, the purpose of the present study was to validate a recently developed brief, yet comprehensive instrument to assess physical activity behavior (Simple Physical Activity Questionnaire – SIMPAQ) (Rosenbaum & Ward, 2016).

Methods

72 exercise and sport science students of the University of Basel were asked to wear accelerometers (ActiGraph® wGT3X-BT) for 7 to 14 consecutive days and to document the non-wear-time. Between the 7th and 14th day, a telephone interview was carried out with all participants including the SIMPAQ and another widely-used physical activity questionnaire (7 Day Physical Activity Recall – PAR). Random assignment was used to ensure that half of the participants first answered the SIMPAQ, whereas the other half first responded to the PAR. After having finished the telephone interview, participants filled in the short form of the International Physical Activity Questionnaire (IPAQ). Across all instruments, physical activity was assessed for the previous 7 days. To test criterion validity, the data of the SIMPAQ was correlated with the objectively assessed accelerometer data. To examine concurrent validity, correlations were computed with the other two self-report instruments (PAR, IPAQ). Additionally, time needed to answer to the SIMPAQ and PAR was recorded. Moreover, participants rated the convenience and intelligibility of the PAR and SIMPAQ items and provided information about their confidence regarding the accuracy of their answers.

Results

With regard to criterion validity, high correlations were found between the SIMPAQ and the accelerometer data for vigorous physical activity (VPA; r=.60, _p_<.01) and moderate-to-vigorous physical activity (MVPA; r=.52, _p_<.01). Lower correlations were found for walking (r=.29, _p_<.05), sedentary activity (r=.28, _p_<.05), and sleep (r=.28, _p_<.05). Self-reported MVPA was lower than objectively measured MVPA (2150 min/week), but yet the SIMPAQ (1559 min/week) was more accurate than the PAR (1036 min/week) and IPAQ (655 min/week). With regard to concurrent validity, the SIMPAQ showed high correlations for MVPA (PAR: r=.59, _p_<.01; IPAQ: r=.53, _p_<.01) and VPA (PAR: r=.57, _p_<.01; IPAQ: r=.54 _p_<.01). No differences between the SIMPAQ and PAR were found for intelligibility and convenience. While less time was needed to complete the SIMPAQ than the PAR (14.99 vs. 18.08 min, _p_<.01), participants reported higher confidence in the accuracy of their answers when answering the PAR (1-10 scale, 6.25 to 6.86, _p_<.01).

Discussion/Conclusion

The SIMPAQ measurement properties appeared as good as those of other established instruments. The SIMPAQ provides the opportunity for monitoring levels of all kinds of physical activity among adults, including sedentary behavior, sleep and other activities than sports. Created for populations with psychiatric disorders at risk of sedentary behavior, this instrument showed reasonable measurement properties, even in a non-clinical and highly active sample. Currently, an international validation study is underway to test the validity of the SIMPAQ in psychiatric in- and out-patients (see www.simpaq.org).

References

Rosenbaum, S., & Ward, P. B. (2016). The Simple Physical Activity Questionnaire. The Lancet Psychiatry, 3(1).

Poster 21

Terwee, C. B., Mokkink, L. B., van Poppel, M. N. M., Chinapaw, M. J. M., van Mechelen, W., & Vet, H. C. W. de. (2010). Qualitative attributes and measurement properties of physical activity questionnaires: a checklist. Sports medicine (Auckland, N.Z.), 40(7), 525–537.

Warburton, D. E. R., Nicol, C. W., & Bredin, S. S. D. (2006). Health benefits of physical activity: the evidence. CMAJ : Canadian Medical Association journal, 174(6), 801–809.

Poster 22

Abstract

Introduction

Tailored interventions are called for in order to promote physical activity effectively. Sport-related motives and goals are presently rarely included systematically in the design of interventions, despite the key role they play in wellbeing and adherence to exercise (Sudeck, & Conzelmann, 2011; Klusmann, Musculus, Sproesser, & Renner, 2016). The Bernese Motive and Goal Inventory (BMZI) allows an individual diagnosis of the motives and goals in leisure and health sports in people in middle adulthood (35-year to 64-year-old). Since his development in 2011 (Lehnert, Sudeck, & Conzelmann, 2011), the questionnaire has been applied in research and practice several times. We have revealed certain indications that the questionnaire should be slightly modified. Thus, the present study aims 1) to cross-validate the original inventory with new samples in the area of leisure and health sports and 2) to examine the necessity of an updated version of the BMZI.

Methods

The study is based on data from two samples: A first sample consist of employees of Swiss companies and authorities. A second sample consists of patients at the beginning of an inpatient medical rehabilitation program in Germany. To explore options for further improvements of factorial validity we added some new items (e.g. to distinct between the factors fitness and health instead of a common factor health/fitness). We used Exploratory Structural Equation Modeling (Marsh, Morin, Parker, & Kaur, 2014) to validate the original and an updated version of the BMZI.

Results and Discussion

The global model fit of the original BMZI as well as of the updated BMZI can be described as satisfactory to good. However, the updated version of the questionnaire fitted the data better. These results indicate that the factorial validity was further optimized. The updated BMZI covers the following motives and goals: Body/Appearance, Contact, Competition/Performance, Fitness, Health, Positive Exercise Experiences, Distraction/Catharsis. The BMZI is recommended as an economical inventory for the individual diagnosis of important psychological preconditions of sport participation in middle adulthood. Future studies should consider to use the updated version of the questionnaire.

References

Klusmann, V., Musculus, L., Sproesser, G., & Renner, B. (2016). Fulfilled emotional outcome expectancies enable successful adoption and maintenance of physical activity. *Frontiers in Psychology, 6*, 1990.

Lehnert, K., Sudeck, G., & Conzelmann, A. (2011). BMZI – Berner Motiv- und Zielinventar im Freizeit- und Gesundheitssport. *Diagnostica, 57*, 146-159.

Marsh, H. W., Morin, A. J. S., Parker, P. D., & Kaur, G. (2014). Exploratory structural equation modeling: An integration oft he best features of exploratory and confirmatory factor analysis. *Annual Review of Clinical Psychology, 10*, 85-110.

Sudeck, G., & Conzelmann, A. (2011). Motivbasierte Passung von Sportprogrammen. Explizite Motive und Ziele als Moderatoren von Befindlichkeitsveränderungen durch sportliche Aktivität. *Sportwissenschaft, 41*, 175-189.

Poster 23

Authors/Affiliation

Einat A. Schmutz[1], Claudia S. Leeger-Aschmann[1], Thomas Radtke[1], Stefanie Muff[1,2], Tanja H. Kakebeeke[3,8], Annina E. Zysset[3], Nadine Messerli-Bürgy[4,5], Kerstin Stülb[4], Amar Arhab[5], Andrea H. Meyer[6], Simone Munsch[4], Jardena J. Puder[5,7], Oskar G. Jenni[3,8], Susi Kriemler[1]

[1]Epidemiology, Biostatistics and Prevention Institute, University of Zurich, Hirschengraben 84, 8001 Zurich, Switzerland

[2]Department of Evolutionary Biology and Environmental Studies, University of Zurich, Winterthurerstrasse 190, 8057 Zurich, Switzerland

[3]Child Development Center, University Children's Hospital Zurich, Steinwiesstrasse 75, 8032 Zurich, Switzerland

[4]Department of Clinical Psychology and Psychotherapy, University of Fribourg, Clinical Psychology and Psychotherapy, Rue P.A. de Faucigny 2, 1700 Fribourg, Switzerland

[5]Endocrinology, Diabetes & Metabolism Service, Centre Hospitalier Universitaire Vaudois (CHUV), Avenue Pierre Decker 2, 1011 Lausanne, Switzerland

[6]Department of Psychology, University of Basel, Missionsstrasse 62A, 4055 Basel, Switzerland

[7]Division of Pediatric Endocrinology, Diabetology and Obesity, Centre Hospitalier Universitaire Vaudois (CHUV), Rue du Bugnon 46, 1011 Lausanne, Switzerland

[8]Children's Research Center, University Children's Hospital Zurich, Steinwiesstrasse 75, 8032 Zurich, Switzerland

Abstract

Introduction

Identifying ways to promote physical activity and decrease sedentary time during childhood is a key public health issue. Research on the putative influences on preschool children's physical activity (PA) and sedentary behavior (SB) is limited and has yielded inconsistent results. Our aim was to identify correlates of PA and SB in preschool children.

Methods

Cross-sectional data were drawn from the Swiss Preschoolers' Health Study (SPLASHY), a Swiss population-based cohort study. Of 476 two to six year old children, 394 (54% boys) had valid PA data assessed by accelerometry. Information on exposure data was directly measured or extracted from parental questionnaires. Multilevel linear regression modeling was used to separately assess associations between 35 potential correlates and total PA (TPA), moderate-to-vigorous PA (MVPA) and SB.

Results

In total, 12 correlates from different domains were identified. TPA and MVPA were greater in boys than girls, increased with age and were positively associated with gross motor skills. Children from single parent families had a higher level of TPA and spent less time sedentary than those living with two parents. Time spent outdoors was positively associated with TPA and negatively with SB. The child's activity temperament was related all three outcomes, whereas parental sports club membership, living area per person and neighborhood safety were associated with SB only. Fixed and random factors in the final models accounted for 28%, 32% and 22% of the total variance in TPA, MVPA and SB, respectively. Variance decomposition revealed that age, sex and activity temperament were the most influential correlates of both, TPA and MVPA, whereas the child's activity temperament, time outdoors and neighborhood safety were identified as the most important correlates of SB.

Discussion/Conclusion

A multidimensional set of correlates of young children's activity behavior has been identified. Personal factors had the greatest influence on PA, whereas environmental-level factors had the greatest influence on SB. Moreover, we identified a number of previously unreported, potentially

modifiable correlates of young children's PA and SB. These factors could serve to define target groups or become valuable targets for change in future interventions.

Poster 24

Title

Qualität im Berufsfeld Sportpsychologie in der Schweiz. Ergebnisse einer Online-Umfrage

Authors/Affiliation

Blaser, M., Stocker, E., Nicola Jänsch & Seiler, R.
Universität Bern, Institut für Sportwissenschaft

Abstract

Einleitung: Die Sportpsychologie entwickelt sich zunehmend zu einem attraktiven Berufsfeld, das von unterschiedlichen Personengruppen ins Blickfeld genommen wird. Es interessiert, inwieweit die verschiedenen Personengruppen Qualitätsanforderungen, die an den Beruf gestellt werden, erfüllen (Birrer & Seiler, 1999; Seiler, 2011). Im Einzelnen geht es um die Frage der Aus- und Weiterbildung, sowie der Qualitätssicherung durch Intervision und Supervision. Methode: In Anlehnung an die Erhebung von Ehrlenspiel, Droste und Beckmann (2011) wurde ein Online-Survey konzipiert und ein Link zur Teilnahme an alle Mitglieder der Swiss Association of Sport Psychology (SASP) sowie Absolventinnen und Absolventen der bisherigen Weiterbildungsstudiengänge für Sportpsychologie in der Schweiz verschickt (N=136). Die Rücklaufquote betrug 59% (N=80), wobei von 50% aller angeschriebenen Personen (N=68) vollständige Datensätze vorliegen. 41% der Teilnehmenden sind weiblich, die Altersspanne reicht von 27 bis 76 Jahren. Rund ein Viertel der Befragten ist neu in das Berufsfeld Sportpsychologie eingestiegen, die Hälfte verfügt über eine Berufserfahrung zwischen 5 und 15 Jahren. Ergebnisse. 87% der Teilnehmenden verfügen über einen Universitäts- oder Fachhochschulabschluss, 71% in Psychologie. 21% gehören der Sektion Mentaltrainer an. 38% haben eine postgraduale Weiterbildung in Sportpsychologie absolviert, 14% in Mentalem Training. 25% geben an, sich mindestens monatlich in strukturierten Intervisionssitzungen auszutauschen, während ein Drittel sich nicht an Intervision beteiligt. Supervision wird von 22% der Befragten nie in Anspruch genommen, von 20% mindestens einmal im Monat. Gut die Hälfte begibt sich mindestens einmal pro Jahr in Supervision. Die jeweiligen Supervisoren sind zur Hälfte Fachpsychologen für Sportpsychologie oder für Psychotherapie sowie zu einem geringen Anteil diplomierte Supervisoren. Diskussion: Das Bewusstsein, dass Intervision und Supervision wichtige Elemente zur Erhöhung der Qualität sportpsychologischer Dienstleistungen sind, ist noch nicht ausreichend entwickelt.

Zeichen inkl. Leerzeichen: 2101 (maximal 2100)

Stichwörter: Qualitätssicherung Sportpsychologie, Schweiz, Supervision, Intervision

Poster 25

Title:

Implicit but not explicit achievement motives dissociate between Swiss elite athletes in interactive vs technique-oriented sports

Authors: Hofstetter D, Endtner P, Suter R, Schüler J, Wegner M
Institut für Sportwissenschaft, Universität Bern, Schweiz

Introduction:

The explicit achievement motive is one of the most researched motivational personality aspects for talent identification in sports. However, recent evidence questions whether the achievement motive is of equal importance for every elite sport. For example, it was shown that high-performance athletes showed stronger achievement motive compared to recreational athletes in technique-oriented sports like athletics (Gröpel, Schöne & Wegner, 2015). In interactive sports like tennis, however, the implicit achievement motive was not able to dissociate between elite and recreational athletes. Following this reasoning, our hypothesis for the present study was that the implicit achievement motive better dissociates between interactive and technique-oriented types of sports than the explicit achievement motive. We further assumed that the implicit and explicit achievement motive is unrelated.

Methods:

Ninety-nine Swiss elite athletes from the two technique-oriented sports of orienteering (n = 31) and shooting (n = 34) as well as from the interactive sport of floorball (n = 34) participated in the study. The implicit achievement motive was measured using the Picture Story Exercise (PSE) utilizing six picture cues to which participants had to respond in written text format. The explicit achievement motive was measured using the 16-item scale of the Personality Research Form (PRF) and the 10-item version of the Achievement Motive Scale (AMS) assessing the strength of hope and fear components of the achievement motive. Differences in implicit and explicit motive strengths were determined using an univariate analysis of variance with type of sport (orienteering, shooting, floorball) as the independent variable.

Results:

In contrast to our hypothesis was the implicit achievement motive (PSE) positively significantly associated (r = .23, p = .021) with the explicit achievement motive (PRF). Regarding the AMS, the implicit achievement was not associated with net hope as the delta between hope and fear component (r = .02).
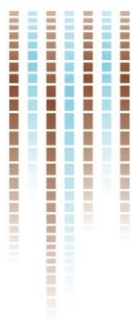
Our hypothesis regarding the difference between type of sports was confirmed. The strength of the implicit achievement motive was significantly lower in the floorball sub-sample (M = 1.94, SD = 1.21) compared to the orienteering (M = 3.55, SD = 1.50) and the shooting sub-samples (M = 3.47, SD = 2.47), $F(2,96)$ = 8.34, p < .0001, η^2 = .15. Neither for the explicit achievement motive measured with the PRF, $F(2,96)$ = 0.25, p = .255, nor for the AMS, $F(2,96)$ = 0.55, p = .579, were such differences present.

Discussion:

The present results are taken from a first available sub-sample of a larger investigation in these three sports and illustrate that the implicit achievement motive may be a valuable predictor for elite sports participation in certain types of sport. In this investigation we are further interested in whether the implicit achievement motive is more strongly linked to practice and competitive behavior than the explicit achievement motives as first evidence already presented (Gröpel, Wegner & Schüler, 2016).

References:

Gröpel, P., Schöne, L., & Wegner, M. (2015). Implizite und explizite Motive von Leistungs- und Freizeitsporttreibenden. *Zeitschrift für Sportpsychologie, 22*(1), 6-19.

Gröpel, P., Wegner, M., & Schüler, J. (2016). Achievement motive and sport participation. *Psychology of Sport & Exercise, 27*, 93-100.

Poster 26

Title

The implicit power motive is associated with accuracy and speed of identifying score-related nonverbal behavior in basketball and table tennis

Authors: Wegner M[1], Schweizer G[2], Furley P[3]
[1] Institut für Sportwissenschaft, Universität Bern, Schweiz
[2] Institut für Sportwissenschaft, Universität Heidelberg, Deutschland
[3] Sporthochschule Köln, Deutschland

Introduction:
The implicit power motive is perceived as the non-conscious, non-verbal, and affect-based need for dominating others physically, mentally, or emotionally. It has previously been shown to be of importance in interactive high-performance sports like table tennis, karate, or basketball (Wegner, Wieland, & Mempel, 2015). Identifying cues that allow dominant behavior is an important precondition for successfully behaving dominantly. Consequently, a power-motivated individual in sports should be especially able to identify submissive or dominant behavior, for example, resulting from scores within a sports competition. Previous studies were able to show that people may identify scores in a competition just by looking at nonverbal gestures of the athletes being ahead or behind in the game (Furley & Schweizer, 2014). For the present study, we hypothesized that the implicit but not the explicit (conscious, socially desirable) power motive predicts accuracy and speed in identifying scores in video scenes from the interactive sports of basketball and table tennis.

Methods:
Sport students (N = 156) from Bern, Heidelberg, and Cologne participated in this study. Nonverbal dominance behavior was measured using a computer-based test of 72 short basketball (BB) and table tennis (TT) video scenes that included videos from the five categories (1) far behind (5 points and more in TT, 15 in BB), (2) close behind (less than 2 points in TT, 5 points in BB), (3) a draw, (4) close lead (not more than 2 points in TT, 5 points in BB), (5) high lead (5 points and more in TT, 15 in BB). We measured accuracy of responses as well as participants' response time to the video scenes. The implicit power motive was measured via six picture cues with the Picture Story Exercise (PSE). The explicit power motive was measured using the Personality Research Form (PRF). We conducted a hierarchical regression analysis to analyze the effect of the implicit and explicit power motive on accuracy of identifying the actual score and the quickness of responses.

Results:
The implicit (β = .25) but not the explicit (β = .03) power motive was a significant predictor of the accuracy, R^2 = .07, F = 10.87, p = .001, of identifying nonverbal behavior in the two interactive sport scenes. The same was true for the speed, R^2 = .03, F = 4.24, p = .041, in identifying the nonverbal behavior: The implicit power motive (β = .15) again was a significant predictor while the explicit power motive (β = .06) was not.

Discussion:
The present study illustrates how an athlete's implicit motive affects how accurately and how quickly cues in the sport environment are perceived that potentially satisfy a person's implicit need. This may even work when these cues are not verbally presented but are only present in nonverbal behavior. Future research might also focus on how even the perception of non-conscious cues are motive-dependent.

References:
Furley, P., & Schweizer, G. (2014). The expression of victory and loss: Esimating who's leading or trailing from nonverbal cues in sports. *Journal of Nonverbal Behavior, 38*, 13-29.
Wegner, M., Wieland, A., & Mempel, G. (2015). The implicit fear of power motive is associated with practice time in elite karateka and tennis players. *International Journal of Sport and Exercise* Psychology. doi: 10.1080/1612197X.2015.1094116.

Poster 27

Title

Exercise-induced trunk fatigue alters pacing strategy during double poling

Authors/Affiliation

Elias Bucher[1], _Øyvind Sandbakk[2]_, _Lars Donath[1]_, _Simone Magdika[1]_, _Ralf Roth[1]_, _Lukas Zahner[1]_, _Oliver Faude[1]_

[1]_Department of Sport, Exercise and Health, University of Basel, Switzerland;_ [2]_Centre for Elite Sports Research, Department of Neuroscience, Norwegian University of Science and Technology, Trondheim, Norway_

Abstract

Introduction

Double poling is one of the main skiing techniques in classical cross-country skiing and has become increasingly important as a result of the introduction of new race events, technological advancements in equipment, as well as improved track preparation (Sandbakk & Holmberg, 2014). Propulsion during double poling relies strongly on the upper body and particularly the trunk contributes to power production in this skiing technique (Hegge et al., 2015). The current study aimed to examine the effects of fatigued core muscles on pacing strategy and technical execution during simulated sprint double poling.

Methods

In a randomized-controlled cross-over trial, 15 well-trained cross-country skiers (mean ± SD; age = 18.8 ± 2.4 years, body height = 177 ± 6 cm, body mass = 69 ± 8 kg, running VO_{2max} = 61.3 ± 6.2 mL·min^{-1}·kg^{-1}, annual training = 567 ± 96 h) completed four identical 3-min self-paced double poling test on a ski ergometer (SkiErg, Concept2, Morrisville, VT, USA) on two separate days. Between the two double poling performance tests on one of the test days, subjects were fatigued during a 25-min exercise sequence targeting the ventral and dorsal core muscles in the experimental condition. During the control condition on the other day, skiers spent an equivalent amount of time at rest between the two double poling tests. Power output (Watt (W)) and poling frequency (Hertz (Hz)) were continuously recorded for each stroke. Mean values for nine 20-s segments were calculated for power output, cycle rate and work per cycle (Joule (J)). Differences between the pre- and post-test change scores in the fatigue and control condition were analyzed using a two-way repeated measures ANOVA.

Results

The difference in performance change from pre- to post-test between the fatigue and control condition gradually decreased with the duration of the performance test. Mean differences in pre-post change scores in performance for the segments 1-9 (95% confidence interval) were: -52 (-82;-21), -52 (-78;-26), -50 (-69;-31), -49 (-65;-33), -47 (-63;-31), -42 (-56;-28), -35 (-51;-19), -35 (-52;-17), -25 (-46;-5) W (all $p < 0.05$). Corresponding differences for cycle rate were: -0.04 (-0.13;0.06), -0.02 (-0.09;0.06), -0.04 (-0.11;0.04), -0.05 (-0.11;0.02), -0.05 (-0.10;0.01), -0.07 (-0.13;-0.02), -0.06 (-0.13;0.00), -0.06 (-0.13;0.01), -0.06 (-0.12;0.01) Hz. Differences in work per cycle were: -45 (-69;-21), -47 (-73;-22), -38 (-60;-16), -32 (-55;-10), -33 (-56;-10), -25 (-45;-5), -21 (-47;5), -20 (-48;7), -10 (-32;12).

Discussion/Conclusion

Exercise-induced trunk fatigue in trained cross-country skiers resulted in a reduced power output, which was most prominent during the first two minutes (22% vs 11% in first and last segment) and could mainly be explained by a decrease in work per cycle. Both force production and technical execution of the double poling movement were negatively affected throughout a 3-min performance bout, after inducing fatigue to main core muscles. This investigation demonstrated the importance of trunk strength and fatigue resistance in corresponding muscles for sprint double poling performance.

References

Hegge, Bucher, Ettema, Faude, Holmberg, & Sandbakk. (2015). Gender differences in power production, energetic capacity and efficiency of elite cross-country skiers during whole-body, upper-body, and arm poling. _Eur J Appl Physiol_.

Sandbakk, & Holmberg. (2014). A reappraisal of success factors for Olympic cross-country skiing. _Int J Sports Physiol Perform, 9_(1), 117-121.

Poster 28

Title

Effects of mindfulness training on athletic performance and performance relevant parameters in sports: A meta-analytical review

Authors/Affiliation

Lucia Bühlmayer[1,2], Daniel Birrer[1], Philipp Röthlin[1], Lars Donath[2]

[1]Department of Elite Sport, Swiss Federal Institute of Sport, Magglingen, Switzerland

[2]Department for Sport, Exercise and Health, University of Basel, Basel, Switzerland

Abstract

Introduction

Psychological skill training is usually applied to patients and athletes. However, few studies examined the effects of mental training issues in sportive populations. This is particularly true with respect to the interrelation between mindfulness and sports performance (Birrer, Röthlin & Morgan, 2012). As a present-oriented method that indirectly affects cognitive processes, mindfulness interventions (Pineau, Glass & Kaufman, 2014) are increasingly considered meaningful within sport-psychological training approaches. Whether mindfulness training serves as a relevant training strategy to improve psychological traits, performance surrogates and sports performance in athletes still needs to be comprehensively elucidated. Therefore, we conducted a systematic meta-analytical review.

Methods

The literature search was conducted in six biomedical databases (CINAHL, EMBASE, ISI Web of Knowledge, PsycINFO, PubMed and SPORTDiscus). The following search terms were used in three search levels with Boolean conjunction: (mindful* OR mindfulness OR mindfulness-base* OR meditat* OR yoga) AND (sport* OR train* OR exercis* OR intervent* OR perform* OR performance-related OR performance-relevant OR capacity OR skill*) AND (health* OR adult* OR athlete* OR sport*). Only randomized and non-randomized controlled trials in healthy sportive participants without clinical conditions (15-55y) that applied mindfulness training techniques (or related techniques on mindfulness) as an intervention compared with an inactive control or with a control following another psychological program were screened for eligibility. Two researchers independently checked for eligibility and study quality [Physiotherapy Evidence Database (PEDro) scale]. Standardized mean differences (SMDs) calculated using the weighted Hedges' g served as main outcomes. Statistical analyses were conducted using a random-effects inverse-variance model.

Results

Nine trials of fair study quality (mean PEDro score 5.6) with 325 healthy sportive participants (from different sports) were included. Mindfulness training varied from one week up to an intervention time over two years. The training sessions lasted from daily training sessions up to a few sessions over a specific time period. The mean session time covered 50-60min. In favor of mindfulness training compared to the control condition, large effects with comparable narrow confidence limits and less underlying heterogeneity were found for mindfulness scores (SMD: 1.03 (90% CI: 0.67, 1.40), $p < 0.001$, $I^2 = 17\%$). Moderate to large pooled effect sizes were found for both athletic performance (SMD: 1.35 (90% CI: 0.61, 2.09), $p = 0.003$, $I^2 = 82\%$) and psychological performance surrogates (SMD: 0.72 (90% CI: 0.46, 0.98), $p < 0.001$, $I^2 = 14\%$). Only physiological performance indices lacked significance and depicted wide confidence limits and notable heterogeneity. However, the effect sizes remained very large with confidence limits that did not touch the zero-line (SMD: 3.62 (90% CI: 0.03, 7.21), $p = 0.10$, $I^2 = 98\%$).

Discussion/Conclusion

Mindfulness training consistently and beneficially modulates mindfulness scores and athletic performance. Interestingly, psychological and physiological surrogates improved to a meaningful extend following mindfulness training. Thus, relevant improvements on sport performance and performance surrogates can be assumed. It seems reasonable to consider mindfulness training strategies as a regular complementary mental skills training approach for athletes. However, more high quality randomized controlled trials on mindfulness and performance improvements in diverse sport settings are needed.

References

Poster 28

Birrer, D., Röthlin, P. & Morgen, G. (2012). Mindfulness to Enhance Athletic Performance Theoretical Considerations and Possible Impact Mechanisms. *Mindfulness, 3*, 235-246.

Pineau, T.R., Glass, C.R. & Kaufman, K.A. (2014). *Mindfulness in Sport Performance*. Handbook of Mindfulness. Oxford, UK: Wiley-Blackwell.

Poster 29

Title

How do rowers regulate their individual behaviour to create a team?

Authors/Affiliation

Mathieu Feigean[1], Mehdi R'Kiouak[2], Reinoud Bootsma[3] & Jérôme Bourbousson[2],

[1]Institute of sport science, University of Bern, Bern, Switzerland; [2]Faculty of sport science, University of Nantes, Nantes, France; [3]Institute of movement sciences, Aix-Marseille University, Marseille, France.

Abstract

Introduction

This study investigates how rowers adapt their individual rowing patterns after starting to row in coxless pair. Human collective behaviours emerge thanks to motor entrainment processes. The interpersonal states are created, maintained and/or disrupted through interactor's adaptive individual behaviours, with respect for the spontaneously emerging needs of the interpersonal coordination. The present case study aimed at observing how experts in individual practice adapt their intra-personal synergies when trained to stabilize an inter-personal synergy.

Methods

Two individual expert rowers (age: 17 years), novice in coxless pair crew rowing, participated in this study. The first data set was collected at the very first step of their encounter, when both rowers began rowing together on the coxless pair (i.e., called pre-training race). The second data set was collected after one and a half month (i.e., about 50 hours) crew-training period (i.e., called post-training race). Both races were organized for the purpose of the study and were fully similar: each consisted in 18-minutes of sub-maximal on-water rowing at 18-19 strokes per min (spm). The races had a run of 341 oar strokes. Two mechanical measures were collected: firstly, the horizontal gate oar angle performed by each rower (°), and secondly, the boat velocity (m.s-1). The data processing was focused on the drive portion of each cycle. Two indicators were calculated to study the interpersonal level, the Root Mean Square (RMS) and the Continuous Relative Phase (CRP). Oar angular velocity was computed as the first derivative of the angular position, using the central difference formula. To capture the specific contribution of each rower, we calculated the oar's linear velocity applied to the oar at each instant, and subtract the boat velocity.

Results

Results are introduced in two parts, interpersonal and individual level of description, respectively. The results showed that the RMS variability for all drives and CRP of a mean drive significantly decreased through team training. More specifically, both rowers changed their individual signatures of rowing in terms of variability, while these changes were not always observed in the same direction. The oar's angle and velocity variability decreases for one rower whereas it increases for the other one.

Discussion/Conclusion

By highlighting that the collective behaviour became more stable through the training practice, our study thus suggests that interpersonal coordination was improved, the variability of the CRP and the RMS decrease in the post crew-training race. Interestingly, the results obtained at an individual level of analysis suggest that these team benefits were obtained through distinct individual adaption (Hill, 2002) of rowers' signatures. Together, the results are discussed in light of how the situated interacting process might be the main process that helps individual experts to give rise to team synergies, and subsequently to function as an expert team (Araùjo & Davids, 2016).

References

-Araújo, D., & Davids, K. (2016). Team synergies in sport: theory and measures. *Frontiers in Psychology*, 7.

-Hill, H. (2002). Dynamics of coordination within elite rowing crews: evidence from force pattern analysis. *Journal of Sports Sciences*, 20(2), 101-117.

Poster 30

Bodies, Gender and Target Practice: Ethnography of Archers and Sport Shooters in Switzerland

Author:
Solène Froidevaux
Centre of Gender Studies, University of Lausanne, Switzerland

Introduction:

A growing number of social researchers investigate sport field with a specific focus of gender. They show us that the admission of women in more and more sport practices doesn't seem to remove the gender stereotypes. Essentialist arguments validating the strength and aggressiveness of men or the sensibility and suppleness of women, can establish a presumed criteria for the sports a man or a woman can do.

There is a numerous archers and sport shooters – a population understudied by sociologists – in Switzerland and the women increasingly participate in these activities. Theses practices seem to belong to a "masculine world", especially because of the Swiss military context and gender stereotypes about weapons and virility (Devreux, 1997). My PhD thesis focuses on these sportive practitioners in some clubs in Switzerland. I am particularly interested in understanding the links between the bodily practices and processes of subjectivation with a particular attention on gender. Are these sportive experiences marked by gender and if yes, in which way? To answer to this question I focus my attention on the bodily ways that people use to learn and to shoot, the discourses of practitioners on the practices and on the objects[1], the manipulation of theses objects and the interactions between the practitioners during the training and after it.

Methods:

My main method is ethnography (observation, participant observation and biographical interviews). I'm halfway trough my PhD research. For the moment I observed during about 70 hours (observations of training in different clubs, regional competitions, open-doors days, initiations in whom I participate, "shoot-parties" in clubs or in national events –for example Rütli Shoot – and observations of events linked to sport shooting - for example weapons' exchange event). I have 15 interviews (7 women : 4 sport shooting, 3 archery; 8 men : 5 sport shooting, 2 archery, 1 sport shooting and archery).

Results and discussion:

Here are my first trails for the interpretation of my data.

The national institutions, the sportive organisations and their rules, the traditions and the national myths contribute to characterize a place where the women are the minority. They constitute a kind of background in the daily interactions between practitioners and they often emerge in the discourses but also in the practice and in the material culture. Considering the myths, the example of Guillaume Tell is interesting. This figure is omnipresent to reaffirm the Swiss values of resistance, lucidity and fraternity but also to characterize the experience of shooting as a national legacy. Theses "structures" (institutions, organisations, myths, etc) can also influence the way that sportswoman and sportsman live and think about themselves in practice. Thus I postulate firstly a construction of a specific subjectivity in this context that is partly determined by the sex-categorisation of someone and the lived-body experience (Young, 1980). Secondly the emergence of a "gender scenography" is often made visible by the interactions, the discourses, the manipulations of objects and the material cultural of these clubs users. For example, the access of weapons in sport shooting is often gendered, as Tabet (1979) argues in her work about the sexual division of tools in prehistoric times. During one of my initiations I have only the opportunity to try the most lightweight and silent gun. I asked for the heavy one but one sport shooter (a woman) said to me that she hates it because it's too powerful and the instructor told me that I could have fear with this type of gun: "It's not a weapon for a woman".

References

Devreux A.-M. (1997). Des appelés, des armes et des femmes: l'apprentissage de la domination masculine à l'armée. *Nouvelles questions féministes, 18*(3/4), 49-78.

---

[1] archery : longbows, bowhunter, barebow and compound bow ; sport shooting : guns, rifles and carbine

Poster 30

Young I.M. (1980). Throwing like a Girl: A Phenomenology of Feminine Body Comportment Motility and Spatiality. *Human Studies 3*(2), 137-156.

Tabet P. (1979). Les mains, les outils, les armes. *L'Homme 19*(3), 5-61.

Poster 31

Influence des choix tactiques sur 800m et 1500m lors des championnats internationaux d'athlétisme

Authors/Affiliation
Louis Heyer[1,2], Georgette Kämpfen[1], Michael Romann[1]
[1]Haute Ecole Fédérale de Sport Macolin, Suisse
[2]Swiss Athletics, Ittigen bei Bern, Suisse

Abstract

Introduction

Afin de pouvoir prendre part à la finale d'un grand championnat international, les athlètes de demi-fond (800m et 1500m) doivent se qualifier via des séries éliminatoires et des demi-finales. Ces courses qualificatives sont formées selon un système de tête de série déterminées par rapport à la meilleure performance de la saison (SB) de chaque athlète. À côté des facteurs de capacités physiques et mentales, la tactique de course influence également le résultat. Le but de cette recherche est d'analyser quelles sont les probabilités de se qualifier pour les tours suivants et de mettre en évidence les patterns tactiques choisis. **Title**

Methods

Les listes de départ de 113 courses de 800m et 1500m (1057 athlètes) des Championnat d'Europe (2012, 2014), du Monde (2013, 2015) et des Jeux Olympiques (2012) ont été analysées. Les athlètes ont été répartis en 4 catégories selon le mode de qualification et leur position dans la liste de départ : grand favori (TOP), favori (FAV), outsider (OUT), no-chance (NOC) (Kämpfen, 2016). Les positions des athlètes à mi-course (400m pour le 800m et 700m pour le 1500m) ainsi qu'aux trois-quarts de la course (600m, resp. 1100m) ont été retranscrites et catégorisées. Des comparaisons des positions à l'aide du test du Khi2 ont été utilisées afin de mettre en évidence des différences de patterns tactiques entre les athlètes qualifiés (Q) et non qualifiés (NQ) d'une même population ou entre genre.

Results

Les pourcentages d'athlètes ayant réussi à se qualifier pour le tour suivant sont les suivants : TOP 89.2% ; FAV 70.6% ; OUT 52.5% ; NOC 21.2 % ; tous les groupes diffèrent significativement les uns des autres (p<0.01). Les choix des positions à mi-course démontrent des différences significatives entre Q et NQ pour NOC (p=0.025), en faveur d'un positionnement plus sur l'avant du peloton. Les patterns de positions entre Q et NQ aux trois-quarts de la course sont significativement différents pour toutes les catégories de coureurs (TOP p=0.001 ; FAV p=0.002 ; OUT p=0.004 ; NOC p<0.001), où les Q sont placés plus sur l'avant de la course. La différence de pattern entre sexe n'est significative que pour les NQ du groupe FAV à mi-course (p=0.041), démontrant une tendance des femmes à être surreprésentées aux positions 2 et 3.

Discussion/Conclusion

Les résultats confirment le caractère ouvert des courses de demi-fond en grand championnat. Un athlète sur 5, qui selon sa SB n'aurait aucune chance, accède tout même au tour suivant. Les patterns de courses permettant de se qualifier invitent à se positionner dans les premières positions aux trois-quarts de la course. Même si les femmes impriment un rythme plus soutenus dans les courses (Heyer et al. 2016), il n'existe que très peu de différences sur les choix des positions par rapport aux hommes. Les athlètes avec un faible pourcentage de chance de qualification doivent prendre des risques et réussir à se positionner dès la mi-course dans la première moitié du peloton.

References

Kämpfen, G. (2016). *Taktisches Verhalten von Mittelstreckenläuferinnen und –läufern an internationalen Grossanlässen* (mémoire de bachelor non publié). Haute école fédérale de sport HEFSM, Macolin.

Heyer, L., Villemin, T. & Romann, M. (2016) : De la probabilité de réussir sa meilleure performance de la saison lors d'un championnat international en athlétisme. In Klostermann, A., & Hossner, E.-J. (Eds.)

175

Poster 31

(2016). *Sportwissenschaft - im Singular! Science du sport - au singulier! 8th Annual SGS/4S-Conference, 18-19/02/2016 in Bern*. Book of Abstracts. Universityof Bern: self published.

Poster 32

Title

Étude socio-historique des systèmes d'éligibilité et de classification des joueurs et joueuses de Hockey en fauteuil électrique: du jeu au sport paralympique

Authors/Affiliation

Laurent Paccaud, Thèse de doctorat réalisée sous la direction de Pr. Anne Marcellini
Assistant diplômé UNIL, SSP, ISSUL

Abstract

Dès la fin du 19ème siècle, la classification des sportifs est une préoccupation importante du sport olympique. Afin de gérer les différences entre les athlètes, des catégories d'âge, de poids et de « sexe » ont été créées sur le principe de l'observation et de la mesure des différences du corps biologique, permettant ainsi une certaine équité dans les épreuves.

Les personnes ayant des incapacités ont, à partir de la deuxième moitié du 20ème siècle, pris leur place dans le monde du sport. Les classifications des sportif-ve-s ont dans un premier temps suivi la logique instituée de la différence du corps biologique, les systèmes de catégories sportives étant conçus à partir d'une « classification selon le type de handicap » (Piéra & Paillé, 1996). Progressivement, un système de classification des athlètes différent émerge: la classification fonctionnelle. Dans le cadre de cette « classification selon le sport pratiqué » (Piéra & Paillé, 1996), qui est soutenue et promue par le Comité International Paralympique (IPC), il ne s'agit plus d'évaluer les corps biologiques mais de mesurer les capacités dans la tâche sportive (Marcellini & Lantz, 2014). Le Hockey en fauteuil électrique, plus communément nommé E-hockey, a vu le jour durant les années 1970 aux Pays-Bas dans des écoles spécialisées pour enfants myopathes. Conçu pour et par des personnes ayant des « déficiences motrices sévères », ce sport offre une possibilité aux personnes circulant en fauteuil électrique de pratiquer un sport d'équipe. Dans sa version compétitive, deux équipes de 5 joueurs et joueuses s'affrontent sur la surface d'un terrain de basketball, poursuivant l'objectif de marquer plus de buts que l'équipe adverse.

Ce poster se donne pour enjeu, à partir de la mise en relation des règlements successifs d'éligibilité et de classification du E-hockey, des règlements de l'IPC ainsi que des modèles médicaux et fonctionnels du handicap, de comprendre les transformations successives des systèmes d'éligibilité et de classification des joueur-se-s de E-hockey et les exclusions de certains d'entre eux et certaines d'entre elles pour la période de 1972 à 2016.

Dans le cadre du processus d'institutionnalisation du E-hockey, poursuivant l'objectif d'intégrer le mouvement paralympique, les acteurs et actrices de ce sport ont successivement adopté trois systèmes d'éligibilité et de classification. Dans le but « d'assurer » une place aux personnes ayant des « déficiences motrices sévères », ces trois systèmes excluent les personnes qui ne correspondent pas à ce critère. D'une période à l'autre, en fonction des modèles du handicap auxquels le mouvement paralympique se réfère, les joueur-se-s éligibles ou non s'avèrent assez différent-e-s. Ainsi, ces formes de catégorisations sportives participent à (re)définir ce qu'est un-e joueur-se de E-hockey et ce qu'est une « déficience motrice sévère », attribut identitaire premier des pratiquant-e-s de ce sport.

Références :

-Marcellini, A., & Lantz, E. (2014). Compétition et classification paralympique. Une nouvelle conception de l'équité sportive? In A. Marcellini & G. Villoing (Eds.), Corps, Sports, handicaps, Tome 2. Le mouvement handisport au 21ème siècle, lectures sociologiques (pp. 61-74). Paris: Téraèdre.
-Piéra, J. B., Pailler, D. (1996). Handicapés physiques et sport, Encyclopédie de Médecine Chirurgicale (Elvesier, Paris), Kinésithérapie-Rééducation fonctionnelle, 26- 155-A-10, 16p.

Poster 33

Authors/Affiliation

Flora Plassard

Institut des Sciences du Sport de l'Université de Lausanne. Suisse.

Abstract

Introduction

Lors du Tour de France 2015, les performances de Christopher Froome ont paru tellement incroyables que, les soupçons de dopage planant, leur crédibilité en a été menacée. Elles ont ainsi suscité des réactions, condamnations, justifications, etc. par lesquelles les différents acteurs engagés dans le cyclisme (coureurs, entraineurs etc.), ou ayant une activité en rapport avec la performance cycliste (journalistes, scientifiques etc.), ont tenté de faire face au discrédit ou ont tenté de donner du crédit à leur propre action. Dans ce poster, nous proposons d'analyser les discours des scientifiques au sein de cette controverse.

Methods

Un corpus composé de 320 articles issus de quotidiens français et de 15 vidéos tirées de chaînes de télévisions françaises et d'autres chaînes d'information et de sport récoltées à partir de la plateforme *Youtube* a été analysé qualitativement avec l'aide du logiciel NVivo.

Results

L'analyse des controverses a permis, premièrement, d'observer la dimension structurelle de l'auditoire (Abbott, 1988) du cyclisme. Il se constitue de différents acteurs : les producteurs de la performance, les régulateurs du spectacle sportif, des journalistes, des scientifiques et des acteurs périphériques qui prennent part à la controverse. Le premier constat est que l'ensemble de ces acteurs jouent leur propre crédibilité professionnelle dans leurs interactions avec les autres membres de l'auditoire.

Prenons l'exemple des experts scientifiques. Comme les autres acteurs ils jouent leur propre légitimité dans leur discours. Toutefois, ils doivent se légitimer à la fois vis-à-vis de l'auditoire et au sein même du groupe des scientifiques puisqu'ils sont en désaccord à propos de la crédibilité des performances de Christopher Froome. Ainsi les scientifiques ont un agenda double : ils cherchent à accroître leur capital symbolique en étant reconnus comme experts du sport, mais ils se battent aussi pour une légitimité interne, dans le champ scientifique.

Discussion/Conclusion

Tout comme les scientifiques, les acteurs qui sont engagés dans et autour de la performance cycliste (qu'ils soient journalistes chercheurs ou entraîneurs) jouent la qualité de leur propre travail et leur propre légitimité professionnelle lorsqu'ils interagissent à propos de la "qualité subjective" du travail de Froome. En conséquence, pour comprendre les controverses sur les performances, il faut saisir les effets des positions des acteurs et leurs propres contraintes professionnelles.

References

Abbott A. (1988). The System of Professions: an Essay on the Division of the Expert Labor, Chicago, University of Chicago Press.

Aubel O., Ohl F. (2015). De la précarité des coureurs cyclistes professionnels aux pratiques de dopage. L'économie des coproducteurs du World. *Actes de la recherche en sciences sociales, 209,* 28-41.

Goffman, E. (1973). *La Mise en scène de la vie quotidienne - La présentation de soi.* Les éditions de minuit, Paris.

Hughes, E. (1996, décembre). Le drame social du travail. *Actes de la recherche en sciences sociales, 115*, 94-99.

Poster 34

Title

Neuromuscular performance of lower limbs six months after ACL reconstruction

Authors/Affiliation

Ralf Roth[1], Marlene Mauch[2], Lukas Weisskopf[2], Lars Donath[1], Lukas Zahner[1], Oliver Faude[1]

[1]Department of Sport, Exercise and Health, University of Basel, Basel, Switzerland; [2]Rennbahnklinik, Basel, Switzerland

Abstract

Introduction

Injuries to the anterior cruciate ligament (ACL) are a major concern in sports. Athletes aim for a fast return to sport after ACL surgery (2). Although no consensus statements on return to sport are available (2), the assessment of various clinical and performance parameters may support a successful return. Strength asymmetry is considered to notably affect biomechanical variables and injury risk at return to sport (3). As athletic demands are challenging and comprise the risk of (re-) injury, athletes should be able to tolerate high biomechanical loads. The present study aimed to assess asymmetries of neuromuscular performance of the lower limbs six month after ACL surgery.

Methods

10 patients (3 women, 7 men; age: 24.4 (SD 3.0) y; height: 174 (11) cm; weight: 74 (15) kg) were compared to 10 healthy controls (age: 29.4 (SD 6.1) y; height 175 (8) cm; weight: 73 (13) kg) who were pair-matched according to sex, height and weight. Six months after ACL surgery (Hamstring autografts) both groups performed a test battery consisting of isokinetic strength testing at a speed of 60°/s (Humac Norm) for knee flexion and extension, gait analysis on a treadmill (Zebris Medical), drop-jumps (drop height 20 cm) on a force plate (MLD), unilateral dynamic postural assessment (TechnoBody), the Y-balance and 6m-timed-hop-test (1). Muscle activity of four muscles (rectus femoris, vastus medialis, biceps femoris and medial gastrocnemius) was recorded at both legs via surface electromyography (myon 320). Muscle activation was calculated relative to maximal voluntary isokinetic contraction (MVIC). Absolute (Δ) and standardized mean differences (SMD) between the injured and uninjured limb in patients as well as between the injured limb in patients and the corresponding limb in controls were calculated with 90% confidence intervals.

Results

In patients differences between the injured and uninjured leg were observed with better results in the uninjured leg for leg extension strength (Δ=-61Nm, [-26;-97], SMD=0.95), dynamic postural assessment (Δ=-146mm, [-66;-227], SMD=0.35) and 6-m-timed-hop-test (Δ=0.23 sec, [-0.09;0.35], SMD=0.51). During drop-jumps muscle pre-activation between legs differed in all muscles (0.64<SMD<1.06) with a particularly higher pre-activation in rectus and biceps femoris in the injured leg. Large differences between patients and controls were observed for drop jump height (controls higher; Δ=-4.6, [-5.7;-3.4], SMD=1.02) and contact time (patients shorter; Δ=-61, [-26;-97], SMD=0.95). Moderate between-group differences occurred with poorer performance in patients for leg extension strength, stride length, unilateral standing balance and Y-balance performance (0.49≤SMD≤0.68). Moderate to large between-group differences in muscle pre-activation (higher in patients) during drop-jumps were measured for all muscles except biceps femoris (0.64<ES<1.45).

Discussion/Conclusion

The results of this pilot study showed that patients six months after ACL reconstruction exhibit different performance and muscle activation patterns in a battery of strength, gait, balance und jump tests. Differences in drop jump performance might be attributed to the altered recruitment patterns of the muscles. Neuromuscular performance tests together with muscle activation assessment may support return-to-sport decisions 6 months after ACL reconstruction.

References

1 Logerstedt, D., Grindem, H., Lynch, & Snyder-Mackler, L. (2012). Single-Legged Hop Tests as Predictors of Self-Reported Knee Function After Anterior Cruciate Ligament Reconstruction The Delaware-Oslo ACL Cohort Study. Am J Sports Med, (40): 2348-2356.

2 Petersen, W., Taheri, P., Forkel, P., & Zantop, T. (2014). Return to play following ACL reconstruction: a systematic review about strength deficits. Arch Orthop Trauma Surg, 134(10), 1417-1428.

Poster 34

3 Schmitt, L. C., Paterno, M. V., Ford, K. R., Myer, G. D., & Hewett, T. E. (2014). Strength Asymmetry and Landing Mechanics at Return to Sport after ACL Reconstruction. Med Sci Sports Exerc, (47): 1426-1434

Poster 35

Authors/Affiliation
Urs Schnyder[1], Daniel Schmid[1], Ernst-Joachim Hossner[1]
[1]Institut für Sportwissenschaft, Universität Bern, Bern, Schweiz

Abstract

Einleitung

Schiedsrichterentscheidungen im Fussball und mitunter die Beurteilung des Abseits entwickelten sich in jüngeren Jahren zu einem blühenden Feld der sportwissenschaftlichen Forschung. Die Abseitsbeurteilung wird durch einen örtlichen Aspekt, der Evaluierung der exakten Position des ballerhaltenden Spielers relativ zum zweitletzten Verteidiger, als auch durch einem zeitlichen Aspekt, dem Moment der Ballabgabe, bestimmt. Bei der Abseitsbeurteilung handelt es sich daher um eine komplexe raum-zeitliche Entscheidungsaufgabe. Die Frage nach der Verursachung von Abseitsfehlentscheidungen von Schiedsrichterassistenten wurde mittels drei Hypothesen (*Shift-of-Gaze*-Hypothese, *Optical-Error*-Hypothese und *Flash-lag-Effect*-Hypothese) zu beantworten probiert, ist jedoch noch weitgehend ungeklärt und die Kontroverse um die drei Hypothesen aus diesem Grunde unvermindert. Um Einsichten in den Entscheidungsprozess, die nicht aus der reinen Verhaltensbeobachtung zu erschliessen wären, zu erhalten, wurde hier ein qualitativer Ansatz gewählt.

Methode

16 männliche Schweizer Elite-Schiedsrichterassistenten nahmen an der Studie teil (M_{Alter} = 32.1 Jahre, SD = 4.9, Altersbereich: 26-41 Jahre). Um relevantes Expertenwissen zu erkunden, wurde eine Kombination aus halbstandardisiertem Interview und der Heidelberger Struktur-Lege-Technik (Scheele & Groeben, 1984), einer Dialog-Konsens-Methode zur Rekonstruktion von subjektiven Theorien, gewählt. Die mittlere Länger der Befragungen betrug 22:06 min (SD = 3:32 min, Bereich 15:46 – 30:11 min). Alle Interviews wurden transkribiert und unabhängig von zwei Bewertern mittels der qualitativen Inhaltsanalyse (Mayring, 2008) analysiert.

Resultate

Unter der Anwendung der Heidelberger Struktur-Lege-Technik entstanden 16 verschiedene Strukturbilder, welche schlussendlich in eine übergreifende semantische Grundstruktur mündeten. Als Voraussetzung für eine korrekte Abseitsbeurteilung sehen die Schiedsrichterassistenten *Erfahrung, Regelkenntnisse, Fitness, Abseitslinie einhalten, Konzentration, Selbstvertrauen, Geduld* und die Idee des „*Im Zweifel laufen lassen*". Diese Grundvoraussetzungen stehen in einer wechselseitigen Beziehung und stellen notwendige Bedingungen für die Beurteilungskriterien dar (*Ballabgabe peripher/auditiv, Antizipation, Hilfsmittel, Erster Gedanke ist der Richtige* und *Fototechnik*). Durch die qualitative Inhaltsanalyse entstanden 48 Unterkategorien, 15 Kategorien und 3 Überkategorien: *(1) Voraussetzungen* (Erfahrung, Konzentration, Selbstvertrauen, Fitness, Regelkenntnisse, Geduld und Im Zweifel laufen lassen), *(2) Beurteilungskriterien* (Ballabgabe, Hilfsmittel, Abseitslinie, Fototechnik, Erster Gedanke ist der Richtige und Antizipation) und *(3) Strategien* (Mental und Physisch).

Diskussion

Als erste Studie, die einen qualitativen Ansatz der Rekonstruktion von subjektiven Theorien innerhalb der Abseitsbeurteilung von Schiedsrichterassistenten im Fussball verfolgt, wurden etwaige Einflussfaktoren identifiziert, welche in einer neuen Forschungsphase der quantitativen Prüfung unterzogen werden können. Zum Beispiel wird die Ballabgabe von den Schiedsrichterassistenten in Wechselwirkung zwischen peripherer und auditiver Wahrnehmung verortet, wobei die periphere Bestimmung als der bedeutsamere Faktor angegeben wird. Des Weiteren scheinen mentale Aspekte wie Konzentration und Selbstvertrauen einen wichtigen Einfluss auf die Entscheidungsrichtigkeit zu haben. Daher können diese Themengebiete für Sportwissenschaftler mit einem besonderen Interesse an der angewandten Arbeit für die weitere Forschung empfohlen werden.

References

Poster 35

Mayring, P. (2008). *Qualitative Inhaltsanalyse: Grundlagen und Techniken.* Weinheim/Germany: Beltz.
Scheele, B. & Groeben, N. (1984). *Die Heidelberger Struktur-Lege-Technik (SLT). Eine Dialog-Konsens-Methode zur Erhebung Subjektiver Theorien mittlerer Reichweite.* Weinheim.

Poster 36

Title

Decision making in Basketball: An empirical study on the involvement of ecological informers and associative knowledge

Authors/Affiliation

Silvan Steiner[1], Yannick Kunz[1]
[1]Institute of Sport Science, University of Bern, Bern, Switzerland

Abstract

Introduction

In interactive team sports, athletes constantly take behavioral decisions in situationally constrained contexts. Ecological perspectives assume that situational cues guide these decisions. Social-cognitive approaches posit that athletes consider internally stored information to complement ecological information. In line with these notions, significant effects of situational information and associative knowledge on passing decisions in Soccer have been found (Steiner, 2015). The aim of this study was to test the existence of similar effects in Basketball.

Methods

Three Basketball teams (N = 38, M = 23.47 years, SD = 6.41) playing in the third regional league of the ProBasket Association participated in the study. For each team, graphic illustrations of ten offensive game situations taken from championship games served as stimulus material. Participants took the perspective of the person on the ball and indicated which of six predefined acts (shooting [option A], penetration towards the basket [B], passes to each of four team members [C to F]) would be their first, second, and third choice respectively. Two measures representing situational constraints in regard to each act were calculated: The amount of defensive coverage by opponents and the openness of the area required to perform an act. Furthermore, participants rated all team members on six items covering Basketball-relevant abilities. The ratings were used to calculate measures of associative knowledge. A variable representing personal (for options A and B) and team members' (options C to F) overall competency and one representing (personal and team members') situation-relevant competency were computed. Ordinal regressions were calculated to estimate the effects of the ecological context and associative knowledge on the participants' decisions.

Results

Results showed significant effects of defensive coverage (β = 1.084, p < 0.001) and the openness of the area required to perform the act (β = 1.086, p < 0.001). The harder a specific act was defended, the lower the chances that this option would be chosen. Chances for an act increased with more space available for its performing. There was no effect of the participants' overall competency rating of the person involved in an act (self-ratings for options A, B; other-ratings for options C to F; β = -0.496, p = 0.222). A significant effect of the situation-relevant competency ratings on decision making was found (β = 1.009, p < 0.001). Pseudo R^2 measures for the model were .116 (Cox & Snell) and .127 (Nagelkerke).

Discussion/Conclusion

The study supports previous findings regarding the importance of ecological informers and associative knowledge in the decision making processes of interactive team sports. Implications for further research are to specify more ecological variables and clusters of associative knowledge and to test their effects on decision making in sports.

References

Steiner, S. (2015). Effects of team knowledge and ecological constraints on decisional processes in customized football game scenarios. In R. Seiler & O. Schmid (eds.), *Sport psychology. Theories and applications for performance, health and humanity. Proceedings, 14th European Congress of Sport Psychology, 14th to 19th July 2015, Bern, Switzerland* (p. 192). Bern: University of Bern, Institute of Sport Science.